PROCEEDINGS

American Society of Sugar Cane Technologists

1946-1950

February, 1953

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Agricultural Section

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THE PRESENT SUGARCANE DISEASE SITUATION IN LOUISIANA

by E. V. Abbott, Pathologist, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture

Presented at the meeting of the Agricultural Section of the American Society of Sugar Cane Technologists, April 18, 1946.

The accompanying graph shows the percentage of the Louisiana sugarcane acreage in disease-resistant varieties for the period 1928 to 1945. From it, it is apparent that since 1930 marked progress has been made in developing varieties with greater resistance to mosaic, root rot and stubble deterioration.

With respect to mosaic, this has been accomplished largely through the replacement of the susceptible P.O.J. varieties, and more recently Co. 281, with resistant ones, leaving Co. 290 as the only susceptible variety that is now widely grown. In the western section of the district, where this variety predominates, mosaic generally has been well controlled in it through roughing.

The curve representing relative acreage of root-rot-resistant varieties shows an upward trend similar to that for mosaic. The replacement of D-74 and Louisiana Purple with the P.O.J. varieties gave some improvement in root rot resistance. However, P.O.J. 234, which for several years dominated the Louisiana acreage; later Co. 281, which at one time occupied nearly 50 percent of the acreage; and C.P. 28/19, which reached a peak of about 13 percent, are all susceptible to root rot. The widespread planting of Co. 290, beginning in 1933, and of C.P. 29/320 in 1935, marked the beginning of a distinct advance in the growing of root-rot-resistant varieties, which has continued with the expansion of C.P. 29/116, now occupying 11 percent of the acreage, C.P. 29/120 with 7 percent, and C.P. 34/120 with 17 percent.

The relative acreage in varieties that are resistant to

stubble deterioration has also increased markedly until at present approximately 85 percent of the acreage is in varieties that are resistant. This does not mean, of course, that we are free of the danger of stubble failures, for stubbling of any of the present varieties may be adversely affected by extremes of cold, excessive rainfall or unfavorable harvesting conditions. It is also possible that red-rot-susceptible varieties, such as Co. 290 or C. P. 34/120, which generally stubble well, may be damaged by this disease in some years. On the whole, however, the hazard of stubble failures is probably less than at any time in the past.

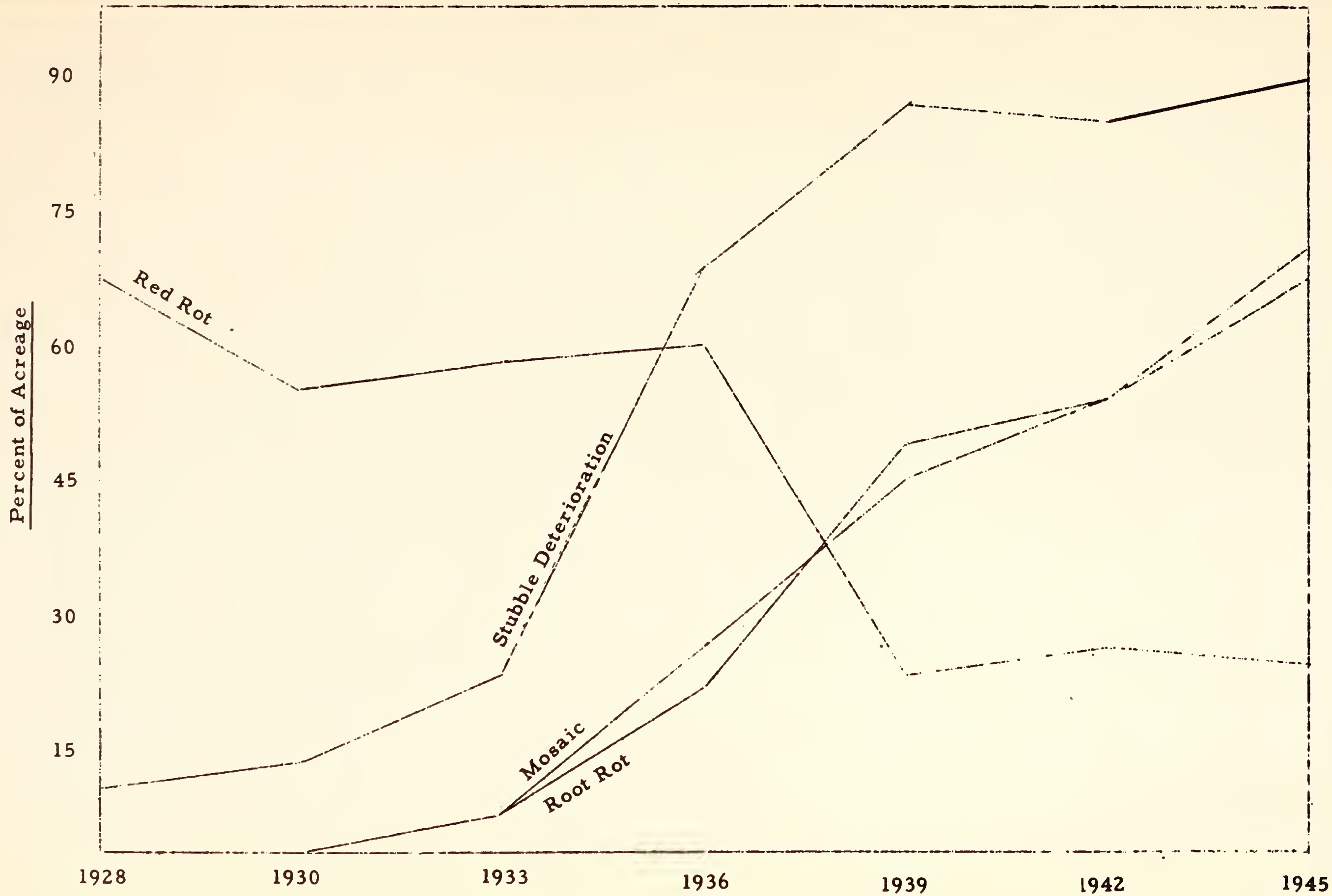
The curve for red-rot-resistant varieties is the only one showing an unfavorable trend. While a marked advance was made between 1925 and 1928, when P. O. J. 234, which is resistant to red rot, replaced the old varieties and occupied a dominant place in the Louisiana acreage, several of the varieties that have come into prominence since then are less resistant. The next highest point in acreage of red-rot-resistant varieties was reached in 1936 when Co. 281 occupied nearly half of the total acreage. The curve then dropped sharply with the widespread planting of Co. 290, which between 1936 and 1939 rose from 7 to 41 percent of the acreage. Since then, the curve has remained at about the same level.

However, the situation with respect to red rot is not as unfavorable as might be indicated by considering the graph alone. Fortunately, the red-rot-susceptible varieties now grown are resistant to other diseases. Possessing resistance to one disease is often an advantage to a variety in escaping or overcoming injury by another to which it is susceptible. For example, Co. 290 and C. P. 34/120, the two most widely grown red-rot-susceptible varieties, are resistant to root rot. There is often a close connection between the extent of injury caused by these two diseases. When cane germinates, shoots and roots develop at more or less the same time. If the rootlets are destroyed by root rot as they begin to develop, establishment of the new plant is retarded or prevented, and the seed cutting may suffer greater damage from red rot than if the roots had been able to develop normally. The root-rot resistance of Co. 290 and C. P. 34/120 may often permit them to establish good stands before they are severely damaged by red rot. In addition C. P. 34/120 is resistant

to mosaic, and Co. 290, while susceptible, possesses greater resistance than many of the varieties formerly grown. Thus, while red rot undoubtedly constitutes the greatest disease hazard confronting the Louisiana industry at the present time, the better general vigor and resistance to other diseases of the present commercial varieties lessens somewhat the danger of serious losses from this disease.

In studying the graph, the question will probably arise as to why progress has not been made in developing varieties resistant to red rot comparable with that for the other major diseases. The primary reason is that the cane breeder has at his disposal for use as parents varieties that are immune to mosaic and root rot, or at least very highly resistant. With respect to red rot, on the other hand, there is apparently no such thing as immunity, and few if any varieties are so resistant that their resistance can not be broken down by unfavorable soil and weather conditions. Furthermore, the fungus causing red rot is more variable than the virus causing mosaic, and probably more so than the fungus causing root rot; that is, there are more different forms or strains of it that differ in their ability to cause injury. This greater variability of the red rot fungus thus makes it more difficult to develop varieties that are resistant to all forms, and greatly complicates the problem of breeding for red rot resistance. Again, varieties that are resistant to the disease may not be suitable for general commercial utilization. This was true of C. P. 28/11, which is very resistant to red rot, but which never occupied a very important place in the varietal picture except in some localities. It is encouraging to note that the recently released variety C. P. 36/105 is resistant to red rot, as is C. P. 36/13, now at the secondary increase stations.

Percent of Louisiana Sugarcane Acreage in Disease Resistant Varieties



CROP RESULTS IN 1945 WITH THE PAVY SYSTEM OF MECHANICAL HARVESTING

by F. Evans Farwell

Presented at the Spring Meeting of the Agricultural Section
Houma, Louisiana, April 18, 1946

As we know, the Thomson Company and the Thornton Company have both developed topping devices which throw the cane tops to right or to left at the operator's discretion. These new devices eliminate the need of the Pavy System of harvesting. This development is a great step and the two above-mentioned harvesting machine manufacturers are certainly to be congratulated and praised for eliminating what has been a very troublesome problem. Where the number of rows in the cut are exactly correct, all hand handling of cane can now be eliminated with the possible exception of the two ditch bank rows.

Many farmers, however, may not have these new topping devices this fall and so it is felt that a thorough discussion of this cutting system that eliminates green tops in the middles may be beneficial. This system of cutting which was reported on last fall basically means that the machine cutting the heap rows travels down one side and back the other in order that no green tops are left in the heap middle. With this system of harvesting, however, a new development occurred, namely, the cutting and piling of six rows of cane to each heap row.

DISADVANTAGES:

(1) Two rows out of every six must be crossed by hand.

(2) In wet weather and on long cuts, more carts must travel over the same rows. This increases the cutting or rutting of the middles. When low spots or bottoms are encountered in a field, it is advantageous to harvest this particular cut in three or four row sets.

As it is usually dangerous to run a heavy harvesting

machine next to the ditch, it is safer to leave the cane for cutting by hand and it may then be thrown on the heap row. These rows can be cut-out at a later date with a Wurtele harvester which cuts the row to the side of the row which its wheels straddle. These rows could be harvested at a time when cane was "backing up" at the derrick and the harvesting operations were having to slow down anyway.

ADVANTAGES:

(1) As stated before, the main advantage sought in this system was to eliminate green cane tops in the heap row. However, the six row heap system has in itself certain advantages.

(2) The trash is more completely burned. The two heap rows are cut out first and then piled by hand. This allows the trash on this cane additional time to dry-out which means that the bottom part of the final heap has the driest trash. When the four additional rows are added to this heap, quite complete combustion is possible. All of the green ends of the cane are not together as is the case in the three rows to a heap system. In the six row heap, three rows have tops to one side and three rows have their tops to the other side. This is very helpful in securing a good burn during the early part of the season. If all types of equipment are available it might be advantageous to use the six row system in the early part of the harvest when the weather is relatively dry and the upper part of the cane has a large percentage of green leaves. In late November or December the system could be changed to the four or three rows to the heap if it appeared advantageous to do so at that time.

(3) With sufficient machines available for cutting with the six row system, each harvester can be set for its particular job, thus eliminating stops to change the position of the discharge gats. However, as some stops are necessary for the removal of trash from the harvesting machines, the above-mentioned advantage is of minor importance.

(4) It is cheaper and easier to burn the trash as there are fewer heap rows. Cane is loaded at a much faster rate as more cane is available in the heap. A full grab-load is available for every swing of the loading boom.

Full loads for the grab mean less spilling and therefore less hand scrapping.

(5) Tractors and carts travel a somewhat shorter distance in the loading position in order to get full loads. The loader has its distance of travel per ton of cane loaded practically cut in half. This all means more capacity for the loader and its crew.

It was found advantageous during the latter part of the season to keep cane cut well ahead of the burning and loading crews. This cane was laid in six row heaps. As long as the trash has not been burned, the cane in six row heaps apparently keeps almost as well as it does in windrow. Preliminary tests showed very little deterioration last fall; however, additional checks on this same subject will naturally be made in the coming season. With the cold weather that usually occurs in December, it is quite advantageous to have some cane cut ahead, provided deterioration is not too great.

To summarize, it would appear that the main advantages to the six row heap are the improved burn of the trash in the early part of the season, the potential windrowing characteristics, and the greatly increased capacity and efficiency of the loading operation.

JOHNSON GRASS CONTROL USING SINGLETARY PEAS

by W. E. Williams

County Agent, Iberia Parish in cooperation with Mr. R. E. Flournoy, Manager, & Mr. Lucius Meyers, Field Superintendent, Orange Grove Sugar Co., Olivier, Louisiana.

Johnson grass may be a valuable plant in its place, but any cane farmer will tell you its place is not in sugarcane.

On Orange Grove Sugar Plantation, located four miles west of New Iberia, La., on U.S. 90 Highway, the infestation of Johnson grass is probably the worst on any farm land of the Parish. Especially in the area of the plantation which is crossed by two railroad tracks. Johnson grass became such a pest on this plantation, especially on the front part near the railroad tracks, that control measures were resorted to by the plantation management. One of the control measures was the planting of Singletary peas, a winter cover crop.

In 1942, on a fifteen acre strip between the U.S. 90 and the railroad track, which was very heavily infested with Johnson grass, second year stubble of C. P. 29/116 yielded 6 tons per acre. This cane was cut early for seed purposes. At that time it was estimated that the Johnson grass infestation on this plot was 60% or better. In the fall of that year, this second year stubble cane was destroyed and Singletary peas were planted in rows at the rate of 40 pounds of seed per acre. They gave an unusual good growth which remained green until early June, 1943. Then a heavy crop of seed set. An attempt was made to combine the seed, but it proved unsuccessful because the Singletary peas were planted in rows, and the combine could not be set low enough to pick up the seed without picking up dirt, so the harvesting of the seed was given up and the Singletary peas were plowed under. The volume of green matter turned under was about 9 tons per acre.

Later on in the summer the land was re-plowed and in September, 1943 it was planted to C. P. 34/120. During the winter of 1943-44, a heavy growth of voluntary

Singletary peas was obtained. In early March the cane was shaved with a power shaver and the Singletary peas were buried during March. The cultivation of the plant cane was the normal method used on the plantation and no fertilizer was applied. The cane was harvested in early September, 1944, and used for planting purposes. It yielded 22 tons per acre.

In the winter of 1944-45, a voluntary stand of Singletary peas equal to the original planting year came up. The stubble was shaved in February, 1945. The cultivation in 1945 was normal. The yields for the entire plot, with the exception of a fertilizer test plot comprising approximately 3 acres, was 21.39 tons per acre. The results obtained in the fertilizer test plots are shown below.

It is estimated by Mr. Flournoy and Mr. Meyers and the County Agent that in 1945, 80 to 85% effective control of Johnson grass was obtained. However, it was observed that the Johnson grass was creeping back in spots, especially near the head lands and ditches which were the principal source of infestation.

In 1944, on this plantation there were planted to Singletary peas 88.5 acres, and 34.0 acres in 1945.

RESULTS OF DEMONSTRATION IN FERTILIZATION OF SUGARCANE ON ORANGE GROVE PLANTATION, OLIVIER, LA., IN 1945.

Cooperator: Orange Grove Sugar Co., New Iberia, La.
County Agent: W. E. Williams

Fertilizer Treatment			
Kind of Fertilizer	Rate per acre (lbs.)	Yield of cane Tons per acre	Sucrose Test
0-0-0	0	24.206	13.95
9-6-9	444.5	30.191	13.95
12-0-12	333.3	24.795	13.96
12-8-0	333.3	30.261	13.30
20-0-0	200.0	24.848	14.13

Variety of Cane - C. P. 34/120 1st yr. stubble
Date fertilizer - 3/23/45
Sucrose test made - December 20, 1945
Cane harvested - January 7, 1946

Presented before the Spring meeting of the Agricultural Section, Houma, La., April 18, 1946.

RUST PREVENTION ON FARM EQUIPMENT

by William H. Carter, Associate Professor
of Agricultural Engineering, Louisiana State
University and A. and M. College

Presented at the Spring meeting of the Agricultural Section American Society of Sugarcane Technologists. April 18, 1946

Ordinary iron and steel as used in the construction of our farm equipment is subject to deterioration of every kind. Unless the surface is protected from corrosion it gradually reverts to an oxide similar to the ore from which the material was made. This tendency for the metal to return to its original state, or rusting as it is known to the farmer, is promoted by the presence of moisture, oxygen, corrosive chemicals and salts, and often stray electric currents. Since farm equipment is operated under one or all of these conditions, and since the manufacturer has not yet found it economically feasible to use materials which are inherently corrosion resistant, the solution of the problem of rust prevention is of interest to all users of farm equipment.

It is difficult to gather data to evaluate in dollars and cents the losses in man-hours, materials, and crops attributed directly or indirectly to corrosion from rust. Professor B. A. Jennings of New York College of Agriculture at Cornell, writing for the Progressive Farmer stated that up to 47¢ out of every dollar spent for machinery repair had been traced to the ravages of weather. In the aggregate the annual loss brought about by rusting is tremendous, but it is one that should and can be greatly reduced through proper direction of effort.

Rust preventive compounds have been on the market for several years and their development and usage were accelerated during World War II. In general these compounds consist of:

(a) Petroleum oils
(b) Special rust proofing oils

(c) Heavy non-drying compounds, or
(d) Hard drying coatings.

They may be applied by brushing on with a paint brush, dipping at some specified temperature, or spraying. In some cases, for spraying, it is necessary to dilute the material with kerosene or white gasoline. At the end of the lay-up period the compounds may be washed off if desired, with kerosene or white gasoline.

Weathering tests to measure their effectiveness have been made, one of particular interest to Agricultural Engineering having been performed at the University of Illinois. The results are well summarized in Chart 1. It is interesting to note that the materials which the farmer ordinarily uses for rust prevention, such as crankcase oil and used transmission oil give protection for about one week, and axle grease not more than 30 days. It seems reasonable to assume that any compound used should give adequate protection from the end of one season's use to the beginning of the next. This may likely be a period from 9 to 12 months. The application then, of the correct compound to the entire machine at the close of a season's use should protect the machine until it is used again and it may safely be stored in the open air. This is the practice suggested for those who through one reason or another, find it necessary to leave their machines outside.

In the belief that Louisiana conditions were more severe than others, weathering tests were started with several available compounds, using as test pieces polished plow points and a field mower. Twelve points were used. Seven commercial compounds were applied and in addition single points were treated with axle grease, spar varnish, linseed oil and paraffin. One point served as a check. A preliminary test made over a year ago proved that crankcase and transmission drainings were not effective over a one week period. Chart II shows observations made to date on the plow point test. At this writing, compounds 1, 3, 7, 8, and 9 appear to be giving satisfactory protection. The field mower was sprayed with hard drying compound number 1 on December 20, 1945. This mower had stood idle for some time and all surfaces were rusted. The entire machine was covered by spraying; 2 quarts were used costing about $.50 per quart. The machine appears as well protected now as when the material was applied. No blistering, peeling or additional rusting are in evidence.

There seems to be no reason why the machine could not be put into use just as it is. A shiny black color is more attractive than a rusty brown. The cutter bar should soon wear bright.

All polished surfaces on a number of disk cultivators belonging to the Agricultural Experiment Station Cane Farm were treated with hard drying and grease types rust preventives. These compounds appear to be giving adequate protection in the open air. The University recently secured a number of machine tools from the War Assets Corporation. Some of these machines appeared to have been stored inside, others outside. All polished surfaces were covered with a non-drying grease type rust preventive. After washing off the compound, the polished surfaces were found to be perfectly preserved.

In order to make most efficient use of rust preventive compounds one should provide himself with spray equipment capable of doing the job in the shortest possible time. A grease gun should be prepared for lubricating all bearings with a compound which is unnecessary to to remove but will serve as a lubricant when the machine is put into service. The compounds selected should be those that need not be removed when the machine is put into operation. Hard drying compounds on the frame parts will serve as the paint and the non-drying compounds applied to the polished parts will wear off shortly after the machine is put into service.

Our suggestions in general, agree with those from the University of Illinois. The following were taken from an unpublished progress report on the Use of Special Rust Preventive Compounds for the Protection of Bright or Unpainted Metal Surfaces of Farm Machinery, prepared by R. I. Shawl.

<u>Suggestions for Application and Use of Rust Preventives on Farm Machinery</u>

1. Always apply an even coating of the rust preventive.
2. Thick heavy applications tend to check or crack and allow rusting.
3. The rust preventives tested gave full protection when applied over wet surfaces.
4. The soft grease rust preventives applied with a brush gave the greatest protection.

5. The soft grease types tested when diluted with 50% regular gasoline to form a spray gave a year of outside protection against rust. (Gasoline diluted material must be kept away from fires.
6. The diluted spray types are best applied with a spray paint gun but can be put on with a hand operated spray gun.
7. None of the commercial ready-mixed spray-type rust preventives tested gave adequate protection against rust under outside exposed conditions.
8. When rust preventives are applied over already rusted metals, most of them stop further rusting and many of them loosen the rust already present.
9. It is advisable to spray the outside, underside and inside metal parts of a combine and similar machines with a rust preventive before putting it into storage.
10. Give all chains a good rust preventive coating. The diluted material gives better penetration into the chain joints.
11. Rust preventives can be removed when necessary with a cloth and petroleum fuel. Many of the soft types will rub off when the implement is put into use.
12. Rust preventives can usually be purchased from the local filling stations or hardware stores in 10# or 25# buckets costing about 17¢ per pound.

In any discussion of rust prevention the question of housing vs the use of rust preventives generally presents itself. Adequate data are not available to serve as a basis for any conclusion and a research program to collect such data would have to extend over a long period of time. Surveys made in other sections indicate that a machine shed represents an investment of from 15% to 25% of the equipment investment which it is to protect. Assuming on a machine shed, depreciation 2.5%, interest rate 3%, repair 2%, of first cost, and insurance and taxes 0.5% of the first cost, the annual overhead cost of owning a machine shed in percent of its first cost is approximately 6.5%. Expressing this in terms of machinery investment, annual housing costs about 1.625% of the first cost of the machinery. (.0625 x 25% = 1.625%). Then for every $100

of machinery investment the annual housing cost is $1.625. At this rate the housing charge on a $90 field mower would be $1.47, and on a $600 cane harvester the same service would cost $87.80. Since machines cannot be stacked, a fair charge might be according to the floor space occupied. Under average conditions a suitable machine shed would cost about $1.00 per square foot of floor area. The annual cost of use per square foot would be 6.5 cents. If a cane harvester occupies 250 square feet, the cost of housing then is 250 x $.065 or $16.25. At the same rate the mower charge would be about $1.50. On most machines housing is conducive to a satisfactory service life.

What is the cost picture when a rust preventive is used and the machine stored outside? It was stated that the material cost for spraying a mower was about $1.00. If rust preventive of the spray, hard drying type has the same coverage as machinery enamel, about three gallons would be required to spray a cane harvester, or a cost of from $6.00 to $7.00 for the material. Any practice that involves labor is to be closely scrutinized these days. It may be that the labor involved in storing and getting a machine out of the shed would cancel that for the application of the rust preventive. No figures are available concerning the service life of a machine when a rust preventive is used. A shorter life than when housed would increase the cost of use when a rust preventive is used and a longer life would favor the use of a rust preventive. The use of rust preventives provides a means for protection of machinery against the weather without an initial investment.

No attempt is made to arrive at conclusions or recommendations. If you begin to think about prolonging the life of your equipment, and have more trouble-free and satisfactory performance, this paper has served a useful purpose.

Material	Nov. 17 '45	Nov. 24	Nov. 30	Dec. 14	Dec. 28	Jan. 12 '46	Jan. 26	Feb. 9	Feb. 23	Mar. 2	Mar. 16
	Dates observations were made										
1	OK	OK	OK	OK	OK	OK	OK	OK	OK		
Axle grease	OK	OK	OK	OK	OK	OK	OK	OK	OK		
3	OK	OK	OK	OK	OK	OK	OK	OK	OK		
Spar Varnish	SR	NC	NC	NC	NC	RI	RI	RI	NC		
5	SR	RI	NC	NC	RI	RI	RI	RI	RI		
Linseed Oil	SR	NC	NC	NC	RI	RI	RI	RI	RI		
7	OK	OK	OK	OK	OK	OK	OK	OK	OK		
8	OK	OK	OK	OK	OK	OK	OK	SR	NC		
9	OK	OK	OK	OK	OK	OK	OK	SR	NC		
10	OK	OK	OK	OK	SR	RI	Rusty	Rusty	Rusty		
Paraffin	OK	OK	RW	RW	RI	RI	RI	RI	NC		
Check (polished)	Rusty										

1. All material applied on polished surface with brush
2. Placed in open Nov. 9, 1945
3. RI - Rust increasing
4. NC - No change
5. SR - Small rust spots
6. RW - Rust forming under paraffin wax

CHART II. Observations to measure effectiveness of several Rust Preventives and other materials in preventing rust on polished steel plow points.

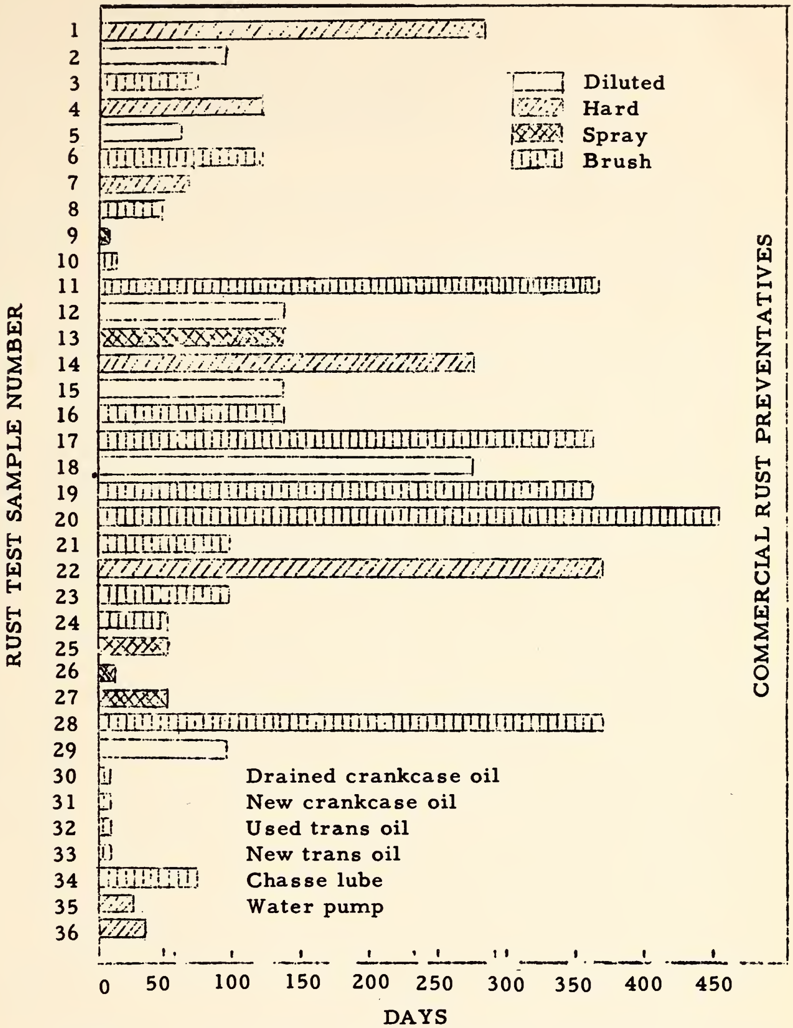


CHART 1. The length of the bars indicates the number of days over which the samples gave rust free protection on polished metal strips. Inspection periods at end of 7, 21, 28, 39, 49, 58, 98, 138, 278, 365, 453, and 479 days.

Note: Chart taken from "Prevention of Rust in Farm Machinery" by R. I. Shawl, appearing in December 1943 issue of Agricultural Engineering Journal.

CONTROL OF JOHNSON GRASS BY THE USE OF SODIUM CHLORATE

by Leon Godchaux II, Godchaux Sugars, Inc.

Presented at the meeting of the Agricultural Section, Houma, La., July 22, 1947.

Johnson grass which has in the past been regarded as a minor nuisance in the Louisiana Sugarcane belt has now become a pest of major proportions. The old time practice of hand pulling of the grass and subsequent burning or throwing in the river are no longer with us, since the infestation of this weed has assumed larger proportions on many of our best cane lands. The result of such infestations is only too well known, particularly by our own company as we have experienced as much as 50% yield decreases due primarily to heavy Johnson grass infestation.

Our company became aware of and concerned about its Johnson grass problem somewhat sooner than most because we were unfortunate enough to be faced with a severe infestation on one of our best plantations, La Place, several years ago. Realizing that the Johnson grass must be brought under control or that La Place would cease to be a productive sugarcane property, we embarked on a comprehensive program to try to bring things under control. The program contemplates control at the earliest possible date with the hopes of eventual eradication, although it is questionable that the latter can be achieved unless our neighbors are willing to follow a similar program. The program in general involves three separate phases; elimination of the weed in the cane field by fallow plowing, maintaining control of re-infested spots in the fallow-plowed fields, and finally eliminating the sources of re-infestation on our ditch banks, turn rows, and headlands. This paper is concerned only with the last part of this program, elimination of Johnson grass on the lands surrounding the cane fields which I will call for the purpose of this discussion, marginal lands.

Our first step in going about this task was drawing up a list of specifications which must be met by any material or means to be used to kill Johnson grass. These specifications essentially are as follows:

(A) reasonable cost
(B) non-poisonous to humans or animals
(C) must kill not only the plant but the under ground root system
(D) easy to apply

Following these rather obvious conclusions, we proceeded to make a study of what had been done in the past on this problem and found that there was little pertinent information available. It is well known that the railroads and others have used arsenic compounds for soil sterilization but this is undesirable due to the extremely poisonous nature of arsenic compounds. It is also well known that sodium chlorate has long been used as a weed killer but no specific information was available on use of this material against Johnson grass. There were also available some of the commercial weed killers such as Ammate as well as some of the dichloro and dinitro compounds. The producers of Ammate evidenced some hope that their material might be effective against Johnson grass whereas the suppliers of the last two materials did not offer much encouragement.

With this information in hand, then, a small scale test was set up to preliminarily evaluate the various methods of Johnson grass control which seemed most promising. These tests conducted last spring and summer involved comparison of sodium chlorate, Ammate, waste pickle liquor, repeated cutting, and repeated cutting followed by burning. Sodium chlorate is a commercially available chemical costing around 8-1/2¢ per pound delivered in carload lots. It is a free flowing dry powder readily soluble in water. It is extremely dangerous when contaminated with organic material as it constitutes in this state a serious fire hazard. Organic materials such as clothing, shoes or wood which have been soaked in a sodium chlorate solution and subsequently dried are liable to spontaneous combustion and ignition due to the very slightest friction such as the rubbing of clothing during walking. Sodium chlorate mixed with certain proportions of organic materials is a well known explosive so it is a material which must be handled with extreme care. In our opinion this constitutes its most serious drawback as a practical weed killer. Ammate is a DuPont product which is supposedly a transfer poison, that is when applied to the leaves of plants it is absorbed into the plant tissues and permeates to the root system

thereby effecting a complete kill. It is available at around 13¢ per pound. Waste pickle liquor is a highly acid waste material from steel plants containing iron sulfate and is the residue from the vats where steel is soaked in the acid for the purpose of removing scale. It is available at cost of transportation but is only a contact killer and was not expected to have any effect on root systems. The cutting and burning tests were conducted with the thought that repeated destruction of the above-ground plant might eventually starve the root system thereby achieving a kill.

The detailed results of these small tests are really not significant due to the very limited size of the test plots as the tests were designed primarily for the purpose of getting a rough idea of which methods should be studied further, therefore, I will not give the numerical results but will summarize our findings as follows:

As expected, pickled liquor achieved only a temporary kill of the above ground portion of the plant. Ammate applied at the rate of one pound per 100 square feet gave a fair kill, which, after three months during which time heavy rainfall was experienced, had considerably reduced the plant infestation and had destroyed the roots of those plants which were killed. Ammate at the rate of three pounds per square foot gave very good results, further reducing the living plants. The cutting and burning tests as anticipated were not maintained on schedule due to the wet weather and as a result, no control was achieved and the results are of no value. Sodium chlorate at the rate of 1-1/2 pound per 100 square feet gave the best results of all, reducing the number of plants per square foot from eleven down to one-half.

On the basis of these tests, and relative material costs, another small series was outlined to more accurately determine the rate of application of chlorate necessary. In these tests, 300 square foot plots were laid out and treated with 3/4 and 1-1/2 pounds of chlorate per 100 square feet. Both rates of application were tested on cut and uncut grass. The results show fairly conclusively, that application to uncut grass is more effective. Both 3/4 and 1-1/2 pounds per square foot gave a good kill, although the heavier application was more lasting in its effects. One of the 3/4 pound chlorate plots was given a second treatment at the end of three months. and at the end of the six

months test period, there was no sign of Johnson grass or any other grass, showing a complete sterilization with a recorded rainfall of 56-1/2 inches. During these tests, it was observed that coco and other grass generally reappeared despite the fact that Johnson grass did not. It was also observed that after a period of a month or two new Johnson grass seedlings appeared on some of the test plots. The chlorate is apparently absorbed by the growing plant tissues and transferred throughout the root system, since it was observed that the complete root and rhizome system of the killed plants were thoroughly destroyed and dried up.

On the basis of these small scale tests in 1946, a larger test program was outlined and initiated in the spring of 1947. A study indicated that each acre of growing cane involved approximately 7,000 square feet of ditch bank and headland which must be considered as the re-infestation source. Sixty acres of fallow plowed lands at La Place Plantation were divided into six similar test plots of 10 acres each. Two plots were treated with 1/2 pound of chlorate per 100 square feet; two plots with one pound; and two plots with 1-1/2 pound. The program contemplates a repeat application at a similar rate to three of the above plots whereas three plots will receive only the one application. In these tests the sodium chlorate was made up to a solution containing the desired amount of chlorate for 100 square foot test plot, in one gallon of water in order that the rate of application in gallons of solution remained constant so as to simplify the application equipment. In other words, solutions were made up containing 1/2, 1, and 1-1/2 pounds of chlorate per gallons of solution. In order to minimize fire hazard, we also used calcium chloride in addition to sodium chlorate at the rate of one pound of chloride per gallon of solution. Calcium chloride being hygroscopic tends to keep the surface sprayed with solution damp. It is also believed that this action contributes to the killing effect of the chlorate.

The equipment used was improvised and rather crude. It involved a 300 gallon tank mounted on a cane cart provided with a four inch opening in the top for charging the tank and a one inch outlet at the bottom leading to a sixteen foot header supported on the after end of the cart. The header was provided with ordinary brass hose nozzles at intervals of two feet and a pipe line strainer was installed in the line to the header. A high pressure air storage tank was

installed in the cart which tank could be charged with high pressure air from a service truck. A line was supplied from this air storage tank through a regulating valve to the 300 gallon tank in order that a constant pressure of thirty pounds could be maintained on the spray system. The spray nozzles were easily turned off when not needed by merely adjusting the nozzle itself. These nozzles were not as good as they should have been as the poison solution was not thoroughly atomized, however, it was a case of hose nozzle or nothing because delivery could not be obtained on the proper nozzle which, however are now on hand. The procedure in handling chlorate involved charging about fifty gallons of water into the tank then introducing the calculated amounts of calcium chlorate and chloride and finally filling the tank with the remaining quantity of water needed. During this time the contents were stirred with an agitator built into the tank, and ordinarily by the time the tank was full of water all of the chemicals had dissolved. This rig was pulled, behind a tractor, at one and one-half miles an hour in one case and in the second case at three miles an hour where a double pass was necessary in order to achieve the rate of application desired.

The first application of chlorate to the six plots was accomplished approximately two months ago, just prior to the wet spell. At the end of about two weeks, an excellent kill was observed on the 1-1/2 and 1 pound plots, not only on the above ground portion of the plants but on the root system as well. The 1/2 pound application gave only a fair kill. The slow speed 1 pass application seemed superior at first to the high speed two pass procedure. At the present time there seems to be no difference between the one pass and two pass plots. After two months, the plots where 1-1/2 pounds were applied are still perfectly clean of Johnson grass whereas the 1 pound and 1/2 pound test plots have shown some regrowth of the seed and some live roots. I would estimate the kill on the 1 pound plots at this date at about 80 percent and on the 1/2 pound plots at 60 percent. We are planning to apply our second dose of poison within the next few days and therefore, have no information on this phase of the tests as yet. We will use our new nozzles for this second application and expect that the finer spray will achieve much better results in complete saturation of the growing plants.

To date no seedlings have appeared on the treated

plots which we may attribute to the dry weather. This may be explained by the fact that the chlorate has not been leached from the surface soil as was the case last year during the period of heavy rainfall.

Our results to date, show that somewhere between 1 and 1-1/2 pounds of chlorate applied to 100 square feet of infested land achieves an excellent kill. The duration of this kill has not yet been determined, but it is apparent from examination of the roots that any regrowth will be from seedlings. Where a 100% kill is not obtained by the first chlorate treatment, it is quite possible that a second spot application to surviving plants, rather than a complete overall second treatment, may complete the kill and yet economize on the amount of chlorate needed. We have no information yet as to whether two general applications of 3/4 pound might not be better than one application of 1-1/2 pounds but will have the information by this fall. We believe that the chlorate treatment in normal years can not be expected to prevent growth of new seedlings in the treated area and have in mind further trials whereby 2, 4-D is added to our chlorate solutions and where 2, 4-D is applied at some date after the chlorate application in order to see whether the germination of seedlings can be inhibited or prevented.

On the basis of a 1-1/2 pound application for 100 square feet and using the figures of 7,000 square feet of marginal land per acre of cane, the cost of chlorate to poison the marginal land in conjunction with one acre of growing cane amounts to $8.92. Add to this cost of calcium chloride which is 1-1/2¢ per pound delivered or $1.05 representing a total material cost of about $10.00. We have no figures on the cost of application but believe that application can be achieved at the same labor cost as ditch bank burning.

In summary, I would say that our results are not yet conclusive and that the cost appears somewhat high. We do not yet know whether chlorate application will be necessary every year but expect that it will not. Chlorate poisons constitute a serious fire hazard and either require special equipment or extreme care in washing equipment directly after use. For the immediate present, we think chlorate looks good since we know of no other more satisfactory or cheaper means of obtaining the results which we have seen on our tests. We fully expect that within the next few years much superior means will be discovered for

eliminating the source of Johnson grass re-infestation on the marginal lands surrounding our cane fields. Until that time, however, and if our present tests continue to look promising, as they now do, our company will undoubtedly go in for general chlorate application next year.

NEWER DEVELOPMENTS IN THE HAWAIIAN SUGAR INDUSTRY

by Ralph J. Borden
Agriculturist, Experiment Station of the Hawaiian Sugar Planters' Association, Honolulu, T.H.

(Informal talk given before a joint session of the Agricultural and Manufacturing Sections of the American Society of Sugar Cane Technologists, Houma, Louisiana, July 22, 1947, as summarized by the Secretary.)

In Hawaii we have adopted the policy of challenging every field practice that has become routine. Through necessity during the war some practices may have been adopted that are probably not the best for the industry. At the time, these changes were believed to be temporary but they may become permanent unless they are challenged. For instance, - we are doing much less deep plowing and soil preparation than formerly; this may or may not be an advantage. We are doing less replanting of ratoons. We are growing fewer old ratoons.

Seed.--For seed selection, the former practice was to go into a field before harvest and take only 1 or 2 seedpieces from the tops of the stalks. Now the practice is to cut whole 7-8 foot length young stalks and cut these into 16 or 18-inch pieces prior to planting. On some of the plantations, the entire stalk has been planted, and this method has given satisfactory results, so we are not sure that we need to cut up these long seed pieces. The short seed pieces are planted with machines, most of which plant two rows at a time. These machines open the furrow, and the seed is dropped into the open furrow, and covered up; fertilizer may be applied at the same time.

A great deal of seed, particularly during the cooler weather, is treated with the fungicide Ceresan before planting. The addition of a dye to the Ceresan makes sure that all of the seed has been treated. Formerly only the ends of the seed pieces were dipped, since experience had shown that the Ceresan had a detrimental effect on root growth, but the present cane varieties do not show this effect. After passing through the cutting saws of one of

our seed cutting machines, the seed pieces fall into a tank of the fungicidal dip, and are then elevated into a storage bin which can discharge directly on to the planting machine.

Irrigation--Irrigation is one of our important field practices in some areas in Hawaii. We have greatly increased the efficiency of our application of irrigation water through improved layouts. Plantations with proper irrigation layouts can now handle 7 acres per day in contrast to 3 to 3 1/2 acres formerly. However, we are still putting on too much water per acre, and so there is renewed interest in overhead irrigation.

Weed control--The field operation we are most concerned with at present is weed control. Some of us are thinking in terms of creating a chemical mulch on our soils to control weeds with herbicides, with the idea that we may eliminate cultivation entirely. With us the sole object of cultivation is weed control. Timing is very important in weed control. Most of our weeds are grasses and they can generally be killed if the chemical is applied before they reach the four-leaf stage. On plant cane this can be about 10 days to 2 weeks after planting, if there has been either a rain or an irrigation so that the weed seeds have germinated. Application of a weak solution of an herbicide at that time will kill the weed seedlings. Then the secret is not to disturb the soil and thus to avoid bringing up another crop of weed seeds. On this undisturbed soil surface there will be very little further weed growth. What there is can be quite easily controlled by "spot" spraying. We are also interested in preemergence control of weeds by spraying the surface of the soil with an herbicide before the weed seeds germinate.

At present we are getting our best results in weed control with a Diesel oil emulsion which contains sodium penta-chlorophenate. This chemical compound greatly increases the efficiency of the oil emulsion. If the weeds are of any great size, there can be some damage to the cane leaves, but so far as we can see the injury to the plant is only temporary. We have not been too successful with flaming in Hawaii, but this may be because the flaming was done on weeds that were too large.

One thing in connection with chemical weed control that we must know is the possible cumulative effect of the chemical being used. We have used tremendous amounts of Diesel oil with the idea of seeing how much could be applied to the soil without affecting the cane growth on such soil. So far, even with over 6000 gallons of oil per acre applied

within a period of 8 years there has been no detrimental effect on cane yields. We do not know what the effect of 2, 4-D or other herbicides may be.

We still have improvements to make in our spraying equipment. Some plantations still favor knapsack sprayers, and if the weeds are sprayed when they are small and a man can cover 3 to 4 acres per day, the knapsack sprayer is effective and economical. Weeds are usually not evenly distributed in the rows and consequently the knapsack sprayer, with which the spray is applied only where needed, is more economical of material than a mechanical sprayer which sprays the entire row.

Fertilization--Through differential fertilization, or the application of phosphorus and potash only where they are needed, we have made a considerable saving in our fertilizer bill. Where mixed fertilizers are applied uniformly over a field there is considerable wastage by applying certain fertilizer elements where they are not needed. This has been overcome by identifying fields or areas within fields that have adequate supplies of these two plant food elements. This identification is possible through the use of rapid chemical and the Mitscherlich soil tests. However, we still have a problem concerned with nitrogen fertilization. This is most important because of the effect of this element on cane growth and maturity. With our two-year crop it is essential that we know by the end of the first year what the second year needs of the crop for nitrogen will be, to produce maximum sugar yields. We must know whether there is enough nitrogen already stored up in the crop, or that can be made available to the crop from the soil, but we don't want to have any left over for this will result in a highly vegetative growth with a relatively low content of recoverable sugar at harvest. The profit or loss from a crop can depend on the complete utilization of the total available supplies of nitrogen. We had hoped that we could use foliar diagnosis, i. e., analysis of portions of the cane leaf, to determine our nitrogen needs, but we have not yet proved that this method is entirely reliable for guidance in nitrogen fertilization.

There is some interest in the possibility of broadcasting our fertilizer, for if we come to overhead irrigation, a good way to apply the soluble fertilizers would be in the water.

The fear of leaching if all the fertilizer is applied at one time may not be justified. Excellent results have been obtained experimentally with applying all of the soluble fertilizer under the seed cane and this is now going into some

field trials. The usual procedure is to make three or four fertilizer applications within the first 6 to 12 months.

Varieties--I doubt that we have a cane variety in the Islands that would be of value to you in Louisiana. This is because our breeding program has been directed toward producing 2-year rather than toward 1-year canes. Our canes have been developed definitely for continual growth through 2 years. The second year's growth makes up a large proportion of the total tonnage we harvest. Our three leading varieties are 32-8560, 32-1063, and 37-1933. A period of testing of 7 to 9 years is usually required before a variety is released to the planters. Release with inadequate testing leads to later disappointments. We are much interested in increasing our collection of breeding canes, and last year in cooperation with Dr. Brandes, some material was obtained from Formosa and is now in quarantine on Guam.

Variety work is of the utmost importance, particularly in connection with disease control. At the present time there are no serious cane diseases in the Islands. Our diseases have been brought under control by the use of resistant varieties. However, Fiji disease which we do not have, occurs on other Pacific islands not far from us. By sending some of our canes to Australia for testing against diseases we do not have, we have found that our important cane varieties are highly susceptible to Fiji disease, so we have recently established a station on Samoa for testing our promising seedling canes for resistance to this Fiji disease.

Maturity-- We are also interested in determining the right state of maturity for harvesting our cane. When the crop is 2 years old, there are some stalks that are from 6 to 14 months younger--in reality our crop consists of 3 age groups. They all go to the mill together. We are therefore giving our attention to more pre-harvest sampling. We have used a procedure whereby, starting about 6 months before the scheduled time for harvesting, a cane sample consisting of all of the cane cut from 10 feet of row is taken, and a "census" is made of the stalks, dividing them into groups according to size and age, and analyzing the juice from the groups separately. This gives a very good guide as to the maturity of the crop. At about 15 months the primary stalks are fully mature. In some fields, as many as 50 percent of the original stalks may be dead at harvest time. We do not know whether the suckers that arise during the second year are the cause of the death of the older stalks, or the result thereof.

Harvesting--Our harvest methods are admittedly not the best, but they have been forced on us. Bulldozers are used with an attachment like a series of fingers that break off and push the cane stalks, tops, and trash into a window. This heap, including rocks and dirt, is picked up with a grab and loaded on trucks, and all transported to the mill. There it is cleaned of rocks and mud, and passed through a stripper to remove the trash and tops. In this process, losses of sugar from the crushing and twisting of stalks and their subsequent washing, may be high; we have measured losses of 10 percent and they may be even higher. A new Department of Agricultural Engineering has been established by the Association, especially to develop a cane harvester. This will have to be able to handle cane crops that average some 80 tons per acre, so their job will not be a simple one.

Transportation--There has been considerable improvement in our methods of transporting cane. Trucks and trailers now replace many flumes and narrow gauge railroads. The use of tractors and trucks in our fields is having a detrimental effect on our soil structure, resulting in puddling. The depressing effect on cane growth is becoming obvious. A very large truck with wide tires is being tried out that will handle 20-24 tons of cane and require less traveling within the fields. The use of automotive equipment for transport of cane has resulted in a big road development program on our plantations.

Training--We have for many years had a Department of Training in the Experiment Station. In this department young men with a college degree receive specialized training for a 2-year period. They work and study in each department of the experiment station, and spend several months on each of several plantations. At the end of their training period they are prepared to take responsible positions on the plantations. A considerable number of our plantation managers and assistant managers have reached their present positions after completing this specialized training, and the industry has recently enlarged and strengthened this program for the development of more of its leaders.

Several new departments have been added to assist in the research activities of our Experiment Station, and we expect to have many valuable contributions from these new departments of Geology, Climatology, and Plant Physiology and Biochemistry.

POWER DRIVEN PLANT CANE HOE DEVELOPMENT

by M. V. Yarbrough, Young's Industries

Presented at the meeting of the Agricultural Section, Houma, La., July 22, 1947

Early in March 1946 the writer received a catalogue and operating instructions covering Dixie Cotton Choppers, Cotton Weeders, Beet Thinners, and Beet Hoeing machines. Quite a voluminous booklet, it was by sheer accident that I noticed the statement that Dixie Machines could hoe any row crop. Cuts of the various machines indicated that they were made for flat cultivation on narrow rows. However my interest was aroused and I immediately contacted the manufacturers of the machines and was invited to visit them in Dallas as soon as possible.

Upon arrival in Dallas I found that the Dixie Machines were manufactured in a very modern and efficient plant owned by Mrs. N.K. Leeper, President of the Corporation. Mrs. Leeper and her engineering staff were immediately intrigued with the idea of trying to develop a machine which would successfully hoe sugarcane. Within two weeks two experimental machines had been built. One of the machines was built by us at Youngsville from basic parts used in various other Dixie Machines. The other experimental machine was built by the Dixie People in Dallas none of whom had ever seen a sugarcane field. In laying out their experimental machine they worked from free hand sketches which I left with them showing profiles of a sugarcane field in various stages of cultivation.

Needless to say, both of these experimental machines were quite crude. We had made them completely flexible with all of the essential and unique Dixie features adjustable over a wide range in order to determine quickly whether or not the basic principle would successfully hoe sugarcane without destroying too much of the crop.

After a few days trial of the experimental machines at Youngsville and also at one of Mr. Foster's farms near Franklin in order to see the machine operating under widely varying soil conditions, the Dixie people returned to Dallas firmly convinced that they could build a machine

which would do the job.

Within three weeks time approximately 20 machines were delivered to Louisiana plantations in the Spring of 1946. In building these machines it had been necessary to use many of the essential parts used on other Dixie machines. Sugarcane cultivation being a very heavy operation there was much doubt in the minds of everyone concerned as to whether the component parts designed for those other lighter machines could stand up to sugarcane cultivation. It was soon determined that mechanically the machines were too weak for sugarcane and the hoeing operation in 1946 was accompanied with a very considerable amount of mechanical difficulty. However the 1946 operation did convince all of us who were interested that plant cane could be hoed with power driven hoes in which the basic Dixie principles were properly incorporated. These principles are properly synchronized rotor and forward motion speeds, proper rotor tip speed and proper rotor spacing. At Youngsville in 1946 we accomplished all of our plant cane hoeing with these machines.

In November of 1946 the Dixie people requested that I return to Dallas to assist them in designing component parts which would be amply strong to give satisfactory performance in hoeing sugarcane.

As a result of two or three conferences in Dallas with the Dixie people, they came up in the Spring of 1947 with the present Dixie Sugarcane Weeder, pictures of which are attached.

Our Youngsville 1947 plant cane crop was laid by with these machines again without any hand hoeing and without mechanical trouble.

We knew from the outset that the Dixie Hoe, which hoes the top of the offbar block through the cane, could do a much better job if Longman or Hebert hoes, working the sides of the offbar block, had preceded the Dixie Hoe. Therefore brackets for carrying the Longman or Hebert Hoes are mounted on the new Dixie Hoe so that, in operation, the offbar block is under compression from the sides by Longman or Hebert Hoes, while the top of the block is being worked by the Dixie Hoe Spinner.

Like any other tool designed to accomplish one step in a complete operation we have found that the work of the Dixie Hoe can be tremendously improved if preceding field operations have been conducted with a view to the use of the Dixie Hoe. In the Youngsville area our plantings are

all quite deep. Drainage permits this deep planting and generally our winter temperatures are several degrees lower than those encountered in the rest of the cane belt from the Bayou Teche area eastward because we have no protecting swamps or marshes to the north of us.

The Dixie machine as presently developed is capable of removing from three to four inches of surplus dirt without any shaving operation ahead of the machine. However we find that a very light shaving early in the Spring removed a great deal of the winter grass from the center of the row and improves the perfection of the work done later on by the Dixie Weeder in that it is easier for the Dixie Weeder to more completely remove Spring grass and roots. We have very little Johnson grass in the Youngsville area but do have considerable Wire or Bermuda Grass. The Dixie Hoe is doing a far better job on the Wire Grass than could be accomplished reasonably by hand.

In our limited experience of only two years with these machines we believe that the best weeding operation can be conducted when the plant cane is from eight inches to twelve inches high. When the cane is smaller it appears to be more tender and more susceptible to breakage. When the mother cane is too tall, many of the suckers are still small and tender, susceptible to breakage, and also the Spring growth is much more deeply rooted and more difficult to remove.

All of the other Dixie Machines are designed for either one row, two row, or three row simultaneous operation. Thus far no work has been done on more than one row operation with the sugarcane hoe. However it is contemplated that next Spring attempts will be made by the Dixie People to develop satisfactory hitches whereby either two or three machines may be pulled by the same tractor. None of the Dixie Machines designed for other crops require more than about one-fourth to one-half horsepower per machine. The Dixie cane hoe, working under our Youngsville conditions and removing approximately three inches of dirt, requires from three to four horsepower per machine. That is, of course, the reason that mechanical difficulty was experienced with the hastily made 1946 Dixie Cane Weeder in which, because of time element, it was necessary to use gear boxes, gears, spinner heads, and other parts which the Dixie people had in stock for incorporation into the lighter machines which they were building for other crops.

To summarize the progress which has been made to date our experience indicates that it is conservative to state:

1. The Dixie people are determined to make available to the Louisiana Industry a machine which will hoe plant cane.
2. They have expended considerable money and effort in providing the machine which they offer today.
3. After two years operation in which all of our plant cane at Youngsville was hoed by the machines and without any hand hoeing, we feel convinced that the principle of operation of the Dixie machine is satisfactory for mechanized operations.
4. We have made attempts to arrive at an average figure representing the percentage of cane stalks destroyed by the Dixie Hoe. Our counts indicate from two to five percent. However the amount of destruction varies so much between different fields with different kinds and amounts of grass and weed growths that it is difficult to mention any percentage figure which would reflect the amount of destruction. It is my opinion that, considering conditions existing in the various fields when the Dixie Hoes are operating, that the amount of destruction of cane stalks is always tolerable when taking into consideration the destruction which would be caused by hand hoeing under the various conditions and also when taking into account the various advantages which we secure through hoeing with the Dixie Machine which cannot be secured by hand hoeing.
5. The Dixie Hoe covers from 1-1/2 to 2 acres per hour. It of course requires an operator as well as a tractor and tractor operator. However the same total work, including dirt removal, could not be secured from hand labor at a rate of more than about 1/2 acre per day per hoe.
6. We are convinced that in our Youngsville fields, with proper crop management and properly done prehoeing operations that the Dixie Hoe will continue to satisfactorily hoe our plant cane crops at considerable advantage and saving as compared to hand hoeing if hand hoe hands were available to us, which they never have been and are not now.
7. For best results either the Longman or Hebert

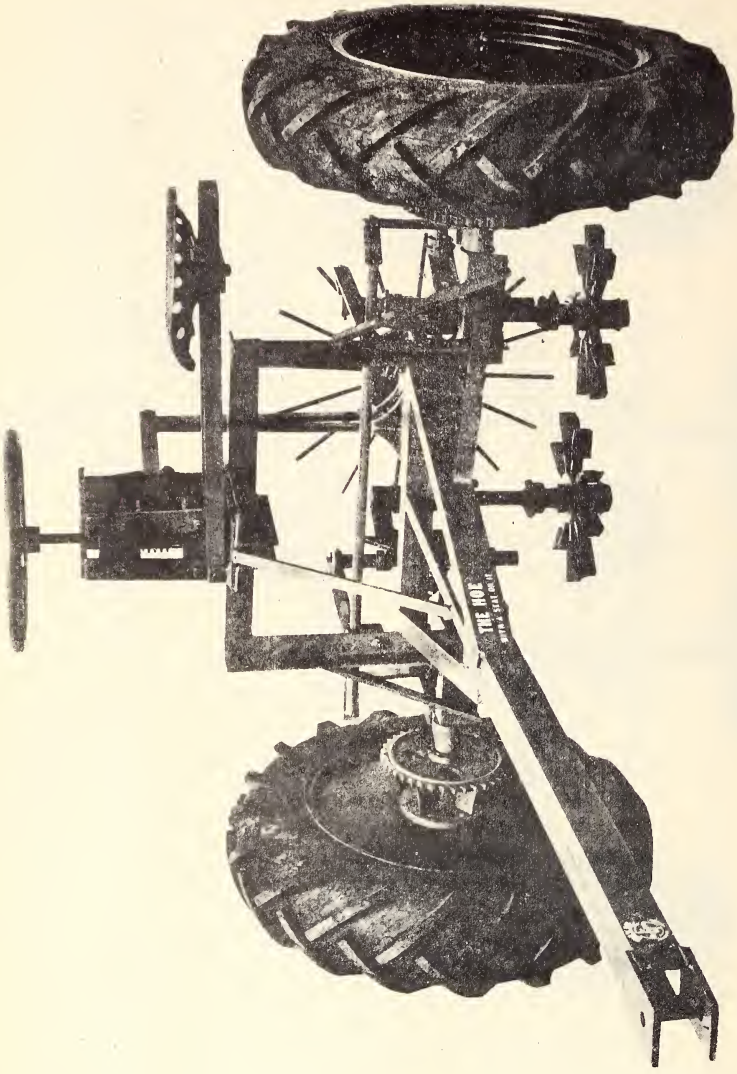
Hoes should be mounted on the frame of the Dixie Machine.

8. Mechanically the Dixie Machine as now offered is entirely satisfactory.
9. Somewhat better operation and considerable longer spinner tooth life will be secured from the Dixie Machine as soon as chrome vanidium spinner rods are available. However the present alloy rods hoe approximately 250 acres per set.

THE NEW, IMPROVED DIXIE SUGAR CANE WEEDER
Manufactured by
N. K. LEEPER, Owner,
The Dixie Cotton Chopper,
412 Factory Street,
Dallas 9, Texas.

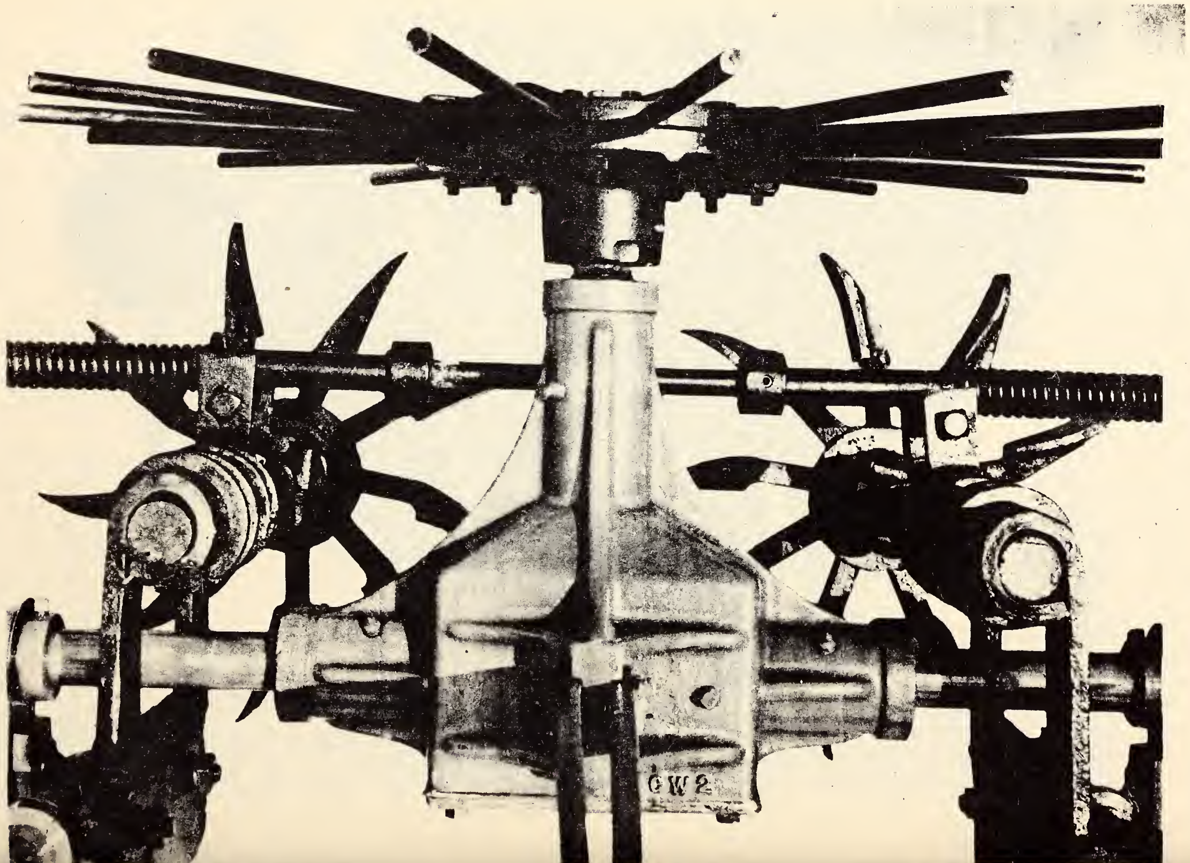
American Motors, Inc., Lafayette, La.

The New, Improved Dixie Sugar Cane Weeder equipped with brackets for carrying Longman or Hebert Hoes.



Three-Quarter view showing installation of seat and lift mechanism.

View from above showing how Longman
Hoes are attached to brackets.



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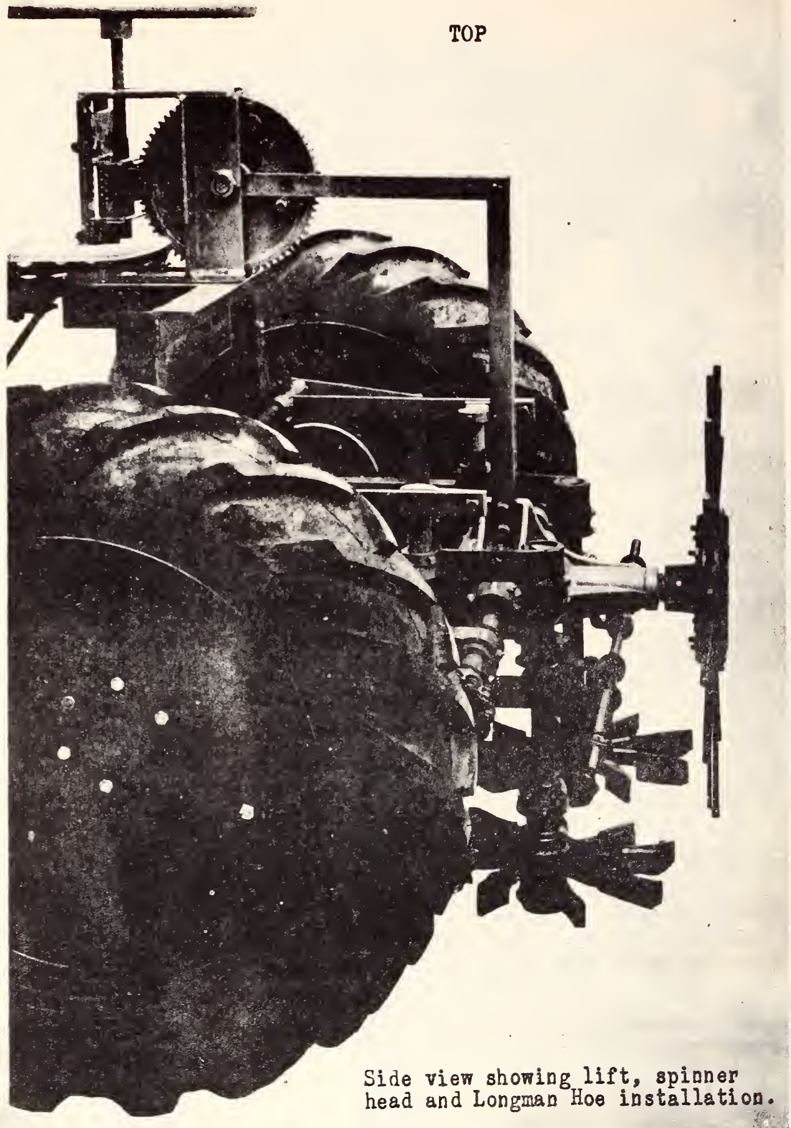

Side view showing lift, spinner head and Longman Hoe installation.

PRE-EMERGENCE TREATMENT FOR SEED WORK

by R. H. Barrow, Manager, Smithfield Plantation*

Presented at the Agricultural Section, Houma, La., Aug. 4, 1948

One of the greatest sources of Johnson Grass reinfestation on our sugarcane plantations today is from seedlings. Fallow plowing, pasturing and other methods have given good results in destroying the rhizomes, but the major problem remaining is the prevention of seedling germination and growth on land after planted to sugarcane. Since land is devoted to sugarcane for two or three years before it is rotated, the reinfestation from seedlings may be enormous.

To combat this problem, a method was needed to prevent or retard seedling germination and to eradicate young seedlings and thereby lessen the reinfestation of lands planted to sugarcane. One of the methods tried was the treatment of land planted to sugarcane by spraying with chemicals before emergence of the Johnson Grass seedlings, or a pre-emergence treatment.

This pre-emergence spraying was first tried at Smithfield Plantation, in the fall of 1946 by L. C. Bourgeois and E. C. Simon on a small scale by spraying land with 2-4-D three weeks after the sugarcane was planted.

The basis of this original work was obtained from the paper, Effect of treating soil and seeds with 2-4-Dichlorophenoxyacetic Acid on germination and development of seedlings, by C. L. Hammer, J. E. Moulton, and H. B. Tukey (Michigan State College, East Lansing) Bot. Gaz. 107 (3): 352-361, 1946.

The 2-4-D was applied as a spray covering the entire surface of the soil at the rate of 4 pounds of 2-4-D Acid equivalent in the form of sodium salt, at a 5000 gallons of water per acre rate. The 5000 gallons of water rate was used to assure penetration and find out whether any adverse affects on the sugarcane

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*Assisted by M. L. Arboneaux, Field Manager

would occur. The field where the experiment was carried out had been fallow plowed all of 1946 and planted to C. P. 36/105 in September 1946. The root stocks of Johnson Grass had been nearly all destroyed but a heavy germination of seedlings was expected because seed heads had formed during a wet period. A check plot was left unsprayed for comparison.

Lack of germination of Johnson Grass seeds was very marked on the sprayed plot, the plot being practically free of grass seedlings in comparison with the unsprayed plot, which was covered with grass seedlings. The sprayed plot had a better stand and growth of sugarcane. In January 1947 row counts of sugarcane and Johnson grass seedlings were made with results as follows:

Plots 100 ft. of row	Stalks of cane	Seedlings of Johnson Grass
2-4-D treated	582	36
Untreated	276	301

The results of this experiment were so encouraging that it was decided to try further experiments in the spring of 1947, using different types of 2-4-D materials and rates of 2-4-D applications.

Mr. F. Evans Farwell who has devoted a great deal of effort and time to Johnson Grass control problem, when shown the preliminary plot work, agreed with us that extensive experiments should be carried out in the spring of 1947 in order to find out whether 2-4-D could be used practically on a field basis for the control of Johnson Grass seedlings and other weeds.

It was felt that all possible information that could be obtained through a careful trial of the available sources of 2-4-D would give information of value as to the proper source to use. Accordingly, several of the major chemical companies were contacted for supplies of their 2-4-D materials. The following materials were obtained: 2-4-D Sodium Salt, Morpholine Salt, Triethylanolamine Formulation, Butyl Ester, and 10% 2-4-D dust. The sodium salt, triethylanolamine, and 2-4-D dust were supplied free of charge through Mr. H. C. Fulton of Standard Agricultural Chemicals, Inc., Hoboken, New Jersey. The morpholine salt was supplied through Dr. J. B. Skaptason of John Powell & Company, Inc., New York, and the butyl ester was purchased from Sherwin Williams Paint Company

Duplicate 1/10 acre plots on a three row basis were used. The bar area only was sprayed or dusted. Three row spray and dust rigs were used. These were driven by independent engines, the equipment being drawn by tractors. The spray rig was equipped with nozzles giving fan shaped sprays.

All notes on the 2-4-D materials are on an acre basis; the 2-4-D acid equivalent is calculated to the same basis in all sources.

Each plot outline shows how the materials were applied and per acre rates as 2-4-D acid equivalent. Dates of application are also given in each plot outline.

Because of the wet spring, applications were delayed until April 10. On that date all applications in plot 165 were made and the one and two pound rates of 2-4-D acid equivalent as sodium salt in 450 gallons of water were applied in plot 168. Showers stopped applications of water rates and dust rates.

On April 22 all other spray and dust applications were made.

Mr. A. E. Camus, County Agent of West Baton Rouge Parish, was present when the 1947 experiments were begun on April 10. He has followed up the experiments and commercial field applications, and has been instrumental in bringing the effective field results to the attention of sugarcane growers of West Baton Rouge Parish.

At the time of the applications of April 10, because of the previous wet period, Johnson Grass and other weeds had begun to germinate. The Johnson Grass seedlings were not over 1/2 inch height to the bud. The showers following the applications resulted in further growth and by April 22 these young plants were well developed and of a larger size.

Plot 165
Comparative Source Test
Spray applied April 10, 1947.

		Check
Sodium Salt 2-4-D 180 gallons water #4	Butyl Ester 2-4-D 180 gallons water #4	Morpholine Salt 2-4-D 180 gallons water #4
Morpholine Salt 2-4-D 180 gallons water #4	Check	Triethylanolamine 2-4-D 180 gallons water #4
Triethylanolamine 2-4-D 180 gallons water #4	Sodium Salt 2-4-D 180 gallons water #4	Butyl Ester 2-4-D 180 gallons water #4

Plot 166
Dust test
Dust applied April 22, 1947

Check	1# 2-4-D per acre	2# 2-4-D per acre
1# 2-4-D per acre	6# 2-4-D per acre	4# 2-4-D per acre
Check	2# 2-4-D per acre	6# 2-4-D per acre
		4# 2-4-D per acre

Plot 168
Water rate per acre test
2-4-D as sodium salt
Spray applied April 10 and 22, 1947

450 gallons water 1# 2-4-D per acre	450 gallons water 2# 2-4-D per acre	900 gallons water 6# 2-4-D per acre
450 gallons water 2# 2-4-D per acre	900 gallons water 6# 2-4-D per acre	450 gallons water 1# 2-4-D per acre
450 gallons water 6# 2-4-D per acre	300 gallons water 6# 2-4-D per acre	check
300 gallons water 6# 2-4-D per acre	900 gallons water 2# 2-4-D per acre	450 gallons water 6# 2-4-D per acre
900 gallons water 1# 2-4-D per acre	Check	900 gallons water 2# 2-4-D per acre
100 gallons water 2# 2-4-D per acre	900 gallons water 1# 2-4-D per acre	100 gallons water 2# 2-4-D per acre

In summing up the results of these experiments based on observations made on April 29, May 6, and May 22, we found the following:

The 450 gallons water and 1# of sodium salt acid equivalent gave a reasonably good control of seedlings up to 1/2 inch bud height. The 450 gallons of water and 2# 2-4-D sodium salt acid equivalent gave a good control on plants of the same size, and the

4# sodium salt 2-4-D acid equivalent in 180 and in 450 gallons of water also gave a result similar to the 2# rate. In the comparative source test the morpholine salt gave a comparable kill to the sodium salt. The results with the Butyl ester and triethylanolamine formulation were not as good. Results from spray and dust applications made on April 22 were not satisfactory. Our explanation is that the dry period following the applications and the size of the Johnson grass plants caused the 2-4-D to be ineffective.

Based on our experiments, we decided that not less than 2# of 2-4-D acid equivalent would be required for pre-emergence weed control under our conditions. As the 4# rate gave us no better results than the 2# rate we decided to use the 2# rate as a base for further work.

Results of our experience also proved to us that soil moisture and rainfall are very important factors in the proper utilization of 2-4-D in pre-emergence weed control work.

Based on our work we felt that when properly used, 2-4-D had definite possibilities for the control of Johnson Grass seedlings in fall planted sugarcane. Plans were made to spray the drills of fall plant with the idea that in the event a season very favorable to germination, growth and seed formation from seedling plants occurred, the drills would be maintained relatively free of seedlings and the middles and sides of rows could be worked lightly by 2-row cultivators to kill the seedlings there. We felt that the seedling problem was the most important problem to be considered on the land planted in the fall which had been thoroughly fallow plowed and where the rhizomes had been reduced to an extremely small percentage. Fortunately, in general, the fall and early winter of 1947 were not conducive to the germination of Johnson Grass seedlings in quantity in direct contrast to the same period in 1946.

As we had no information to guide us except our own work, we were very much concerned about making applications of 2-4-D to fall planted sugarcane, as we felt that there might be a difference in reaction because of conditions different from our previous experiments.

A brief report on the work of Dr. H. F. Clements of the Hawaiian Agricultural Experiment Station, in the Times Picayune indicated that 2-4-D had possibilities in that country for weed control in sugarcane. Air mail correspondence with Dr. Clements in answer to our questions indicated that there was a definite possibility that the eyes of sugarcane might be adversely affected if sufficient quantities of 2-4-D penetrated down to them.

Nevertheless, in view of the seriousness of the Johnson Grass seedling situation, the Management of Smithfield Plantation decided to spray 340 acres of fall plant cane on land that was well fallow plowed during 1947. It was decided also to spray each of the commercial varieties to see if there was a difference in reaction. Based on our 1946 experiment we had concluded that in the case of the variety C. P. 36/105 there was a definite stimulation of growth and suckering.

When making the spray applications, a rate of 2 pounds of 2-4-D acid equivalent in the form of sodium salt in 100 gallons of water per acre was adhered to in a coverage of 36 inches on the row top.

One plot of C. P. 36/13 which had been planted about 15 days prior to spraying, received an extremely heavy application of approximately 10 pounds of 2-4-D in 500 gallons of water per acre. Because this application was 5 times the plantation rate, this plot has been very carefully watched since spraying, as it was felt that if this plot and this variety gave normal stands, suckering and growth in the spring of 1948, there should be no danger in the fall application of 2-4-D on sugarcane at the rate commercially used. There was a marked reduction of germination in the fall of 1947 in the plot, although the eyes were sound. During the spring of 1948 the plot filled out to a good stand, suckered normally and showed no ill effects from the heavy application of 2-4-D the previous fall.

In view of the fact that we had been warned by Dr. Clements that 2-4-D might adversely affect germination and also found out from our own experience with C. P. 36/13, that penetration had induced dormancy of ungerminated eyes and caused gappy fall stands, we felt that spring applications should not be made until satisfactory stands had come out. We felt, however, that there was a gap in our weed control program, between very early spring, after the dirt had been removed from the plant cane crop and the time that this crop came out to a satisfactory stand. At the suggestion of Dr. Clements we tried sodium pentachlorophenate which he had indicated had little adverse effect on the eyes of sugarcane under Hawaiian conditions. We also tried Dow Selective which we felt had possibilities for this purpose. (Preliminary experiments with these materials in the late fall of 1947 indicated that they would not damage sugarcane foliage severely.) At the rates used this spring, both of these materials have possibilities for this early work.

On March 29, 1948 field spraying of 810 acres of plant cane

was begun. The cane at that time was out to a good stand. An 18-inch strip on top of the row was sprayed, as we felt this to be the most practical and economical way of spraying. As our previous work indicated that soil moisture and rainfall were more important than the water in the spray mixture and an 85 gallon per acre water rate gave us good coverage, this amount of water was used. We maintained our 2 pound per acre rate of 2-4-D acid equivalent in the form of sodium salt. (.50 pounds per acre in area sprayed.) Rainfall conditions were conducive to the action of 2-4-D sodium salt and the results obtained were better than we expected. No damage to suckering was noted and the effect on cane growth appeared to be beneficial. We consider it probable that the hormone chacteristic of 2-4-D is responsible for these beneficial effects.

In following through the results from the spray application begun on March 29 the action of 2-4-D was as follows:

The first beneficial results began to show up on the eight day after applications begun, Small seedlings of Johnson Grass, Red Root, and other grasses and weeds began to die out. In about twenty-five days, first showing up on blackland, then on mixed and last on the sandy land, larger seedlings showed definite and severe root injury. Johnson grass seedlings up to a height of five inches and larger had their root systems so badly damaged, that there were only a small quantity of live roots left in the soil. Some of the Johnson Grass plants did not have sufficient remaining sound roots to permit them to maintain their normal erect position. There was little underground rhizome development on these affected Johnson Grass plants. The base of these plants had been pushed to the soil surface. When the crew spotting out Johnson Grass plants went through the fields that had been sprayed forty days, where the rhizome development had been stopped and the root systems badly weakened, they were able to do an efficient job.

We have approximately 500 acres of plant cane that has never been hoed since spraying, previous to spraying this plant cane had been shaved and rotary hoes passed over it to kill out the first crop of young grass. Bars were left open for approximately fifty days, which allowed this cane to sucker without hindrance from excess dirt over the bars, and there was no competition from grass. A small number of seedlings were able to maintain themselves and grow to the seed head size; these seedlings are being removed by the spotting crew.

The three row sprayer used was built at the Smithfield Plantation Shop by L. P. Boudreaux, our head mechanic. It was built specifically for the job in mind, with the proper adjustments for row height and width. Strainers and nozzles were purchased from Spraying Systems Company of Chicago and found to be excellent. Mr. Boudreaux has devoted much energy, time and thought to the development of this piece of equipment.

Spraying that was begun on March 29 was finished on May 4, and very little trouble in spraying and handling of the equipment was experienced.

At the present tine, June 4, following a clean mechanical lay-by, a blanket spraying of the entire row at the rate per acre noted above, is being carried out. The original spray equipment is being used in this work, and an additional duplicate sprayer has also been put into operation. In order to get the maximum efficiency out of our equipment for economy and also due to the time limit for this kind of spraying, we have a truck servicing these sprayers in the fields. This truck is equipped with a 1300 gallon tank and pump, that delivers the ready mixed solution to the sprayers on the head lands, thereby, eliminating much loss of time. With this service the two 600 gallon spray rigs are spraying approximately 90 acres per day. It is planned that the 810 acres of plant cane will be treated in this manner.

Our original work in the fall of 1946 and the spring of 1947, in the case of grasses, indicated that only small Johnson Grass and other grass seedlings were adversely affected by pre-emergence applications of 2-4-D. However, our 1948 results have shown that under certain conditions the root systems of relatively large Red Root and Johnson Grass plants in particular are badly damaged by the action of 2-4-D. They are damaged to such an extent that it makes them susceptible to other means of eradication. We have also found that in some cases rhizomes of Johnson Grass plants up to medium size have put on leaves on their tips and these tips have emerged above ground, instead of continuing downwards as rhizomes.

There was found to be a definite difference in 2-4-D effectiveness on soil types. We have found that on black and mixed land more effective results have been obtained than on sandy land, although results on sandy soils have been very satisfactory.

The commercial applications on Smithfield Plantation have been made using 2-4-D in the form of the sodium salt. Results with other 2-4-D materials indicate that combinations of 2-4-D materials may be more desirable than applications of only one form

of 2-4-D In the 2-4-D applications, preliminary cultivation practices have been such as to eradicate as much as possible weeds in the drill - just ahead of the spray cultivators. This combination of mechanical and spray cultivation in the drills has proven practical so far this year.

Milliken and Farwell, Inc. wish to thank Mr. E. C. Simon, Agronomist, Baton Rouge, Louisiana for the valuable assistance he has given us at Smithfield in working out our spray cultivation. His interest in this work and his knowledge of chemicals and the cultivation problems of the sugar planter have enabled us to work out this program in record time. His research into the use of 2-4-D and other materials has taken much of the guess work out of the weed control work we are doing.

PAST EXPERIMENTS AND FUTURE PROSPECTS OF ARTIFICIAL RAIN MAKING

by Charles A. Farwell, Milliken & Farwell

Presented at the meeting of the Agricultural Section, Houma, La., Aug. 4, 1948.

So much has been written about the pros and cons of producing rainfall by seeding cumulous clouds with dry ice and other stimulators that we feel that we should first frankly state what we think are the possibilities of obtaining good results with the equipment now available.

We do not feel that these attempts to produce rainfall are in the nature of attempting a miracle or supplanting the work of nature. We simply feel that by the use of the dry ice method under proper conditions, we can produce rain where it would not have otherwise have fallen.

In our opinion, the minimum requirements for the production of rain in a given locality by the dry ice method are as follows:

1. Well formed large cumulous clouds
2. These clouds should have at least a thousand feet of the cloud extending above the altitude at which the temperature is 32° F.
3. A moisture content of 50% or better at and above the freezing level.
4. Winds at the freezing level and above, traveling in the same direction as surface winds. Or, preferably, practically no wind at all in the upper levels.
5. Last, but not least, an aircraft which is capable of flying at the necessary altitudes, and a pilot and crew trained to do this work.

The first attempt on our part to produce rain by the dry ice method was made on August 9, 1947 in the marsh area south of Morgan City, Louisiana. On this day a cumulous cloud was seeded with dry ice at 19,600 feet, with the results of producing a heavy shower in the area

approximately 5 miles southwest of Morgan City. A check with the Weather Bureau established the fact that this was the only rainfall within an area of approximately 50 miles in all directions during that day. We have photographs of this entire operation.

Our next attempt was on September 10, 1947 when the plane was stationed at Harding Field in Baton Rouge. No satisfactory clouds developed that day, so the plane remained in Baton Rouge and took on a fresh supply of dry ice on the morning of September 11, 1947. There were no clouds developing in the area of Baton Rouge that morning or in the early afternoon. Therefore, at about 2 P.M. the pilot of the plane was instructed to fly to Donaldsonville and thence down Bayou Lafourche in an attempt to locate a suitable cloud. He was instructed that if no suitable cloud was encountered to fly back to Donaldsonville and then on in to New Orleans. At approximately 2:30 P.M. a group of suitable coulds were encountered approximately 40 miles southeast of Baton Rouge. The center cloud of this group was considered the best, and two attempts were made to drop ice into this cloud. However, on the first two attempts, the cloud was climbing so fast that the plane could not go over it. On the third attempt, at which time the cloud had reached an altitude of about 17, 500 feet, approximately 70 pounds of dry ice was dropped directly into the top of the cloud. At approximately 3:30 P.M. rain began to fall from the bottom of this cloud, and at approximately 3:45 P.M. the cloud had reached its maximum development at a height estimated to be above 30, 000 feet. The rainfall from this cloud was recorded as being 52/100ths of an inch in the rain gauge at Reserve. The rain extended over the entire area of Reserve Plantation and continued on in to the woods north and northwest of Reserve Plantation.

The only other rainfall on that day occurred over New Orleans, and southwest of Morgan City. The conclusion reached in the informal report on this experiment by the officials of the Weather Bureau was as follows:

1. The rainfall recorded at Reserve was a result of the seeding experiment, and

2. Rain would not have occurred without the seeding.

Our next attempt was made on June 23, 1948. However, on that date the cumulous clouds did not develop sufficiently to go above the freezing level, and therefore no drop of dry ice was made.

On June 28, 1948 the plane worked the area bounded by Houma, Thibodaux, Donaldsonville, and Convent. The plane left New Orleans Airport at 12:30 P. M., and proceeded to Little Texas. Upon reaching its destination, it climbed to approximately 18, 000 feet and seeded with dry ice the selected cloud. After seeding this cloud, the plane descended to roughly 10, 000 feet and developments were observed. It was noted that this cloud proceeded in a northerly direction and after approximately 25 minutes began to rain. A second drop of dry ice was made in the center of a three cumulous type cloud formation. This drop was made southwest of St. James, roughly in a line between Napoleonville and St. James. Upon observing the reaction of this drop, it was noted that not only the center cloud reacted to the drop, but also the two outlying clouds, thus giving the impression of a chain reaction. Considerable rain was noted to fall over the St. James-Lagan-Convent area.

On June 30, 1948 the same area was worked as on June 28, 1948. The clouds were seeded in an approximate area of Morgan City and Gibson at 19, 000 feet. The wind was from the south this time. After dropping the ice, it was noted that the camera was broken, and the plane had to return to New Orleans for another. Upon returning to the seeded area, a heavy rain shower was noted to fall over the western portion of Little Texas and over Lake Verret, thus indicating that the wind had swung slightly southwest from the south. In seeding this cloud, which was a double-headed cumulous cloud, only one side was seeded, and although it produced rain within about 30 minutes, it was noted that the other portion of this cloud began to rain after about an hour and 20 minutes, as shown in the photographs of June 30, 1948 flight.

On June 10, 1948 the next attempt was made. In this experiment we were trying to drop the rain within a very narrow area, that is, an area extending from Thibodaux to Labadieville. This experiment was a prime example of the need for radio contact between the plane and a trained ground observer. The Navy had agreed to fly reconnaisance flights that morning and give us a report on the cloud formations. All during the morning and up until 12:30 P. M. we had received reports from the Navy of excellent cloud formations southeast

and east of Houma. The prevailing winds were from the East. However, during the time that elapsed between the plane's take off from New Orleans and the time that these clouds were seeded, the winds aloft had shifted to South. Had the pilot been able to know this, he could have dropped his dry ice south of Thibodaux instead of east of Thibodaux. However, not being able to communicate with the ground, he followed his last instructions and dropped the ice in well-formed cumulous clouds in the area between Lake Boeuf and Thibodaux. Photographs of this flight show that excellent rainfall was produced and actually came within a half mile of the area over which it was intended, but then due to the shift in the winds, the rainfall continued in a northerly direction, finally crossing the Mississippi River in the neighborhood of St. James and Lagan, Louisiana.

On July 17, 1948 the plane left New Orleans at approximately 1:15 P.M. with the idea of going to Houma and observing the clouds in that area. When the plane reached the neighborhood of Delta Farms, it encountered a large cumulous formation and dropped part of its ice into this formation, with the result that a heavy shower was observed by the writer to fall in the area between Lockport and Raceland, Louisiana. The next drop was made slightly south of Houma and resulted in a heavy shower in the Houma-Ashland area. Again on this flight we had the cooperation of the Naval Air Service and found a large cumulous formation that had travelled from a point approximately 10 miles southeast of Houma to a point about 15 miles east of Jeanerette without producing any natural rain. Upon instructions, the pilot dropped dry ice into this large formation, with the result of producing a heavy shower in the area around Jeanerette, Louisiana. The drop was made at approximately 18,000 feet. The pilot of the aircraft reported that rain was observed falling from the bottom of this cloud shortly after 3 o'clock and rain was still falling at about 3:45 when the pilot again flew over this area and subsequently landed at New Iberia, Louisiana.

The next attempt was made on July 24, 1948. The plane took off from the New Orleans Airport at roughly 9 A.M. and landed at Houma awaiting for suitable clouds. No suitable clouds developed during the day, and at approximately 1:00 P.M. the plane took off from Houma, with the idea of returning to New Orleans. However, in the area between Thibodaux and St. James, two clouds that gave the impression of being the suitable height were noted. The pilot decided to seed these clouds and climbed 19,800 feet. Two

clouds were selected right together and dry ice was dropped into the tops of both of these clouds. This took a little longer, and after approximately 35 minutes these clouds in the process of being developed moved south of Thibodaux to Lafourche Crossing and began to rain. This rainfall was noted by the weather observer at Schriever and was officially reported by him as a heavy rain which occurred from 2:30 to 3:30 P.M. The plane did not remain in the vicinity and we therefore have no way of knowing whether the heavy rain at Houma later that afternoon was out of this same cloud, but inasmuch as this cloud had travelled steadily from north to south, we presume that it was the same one.

The results obtained in the flights described above lead us to believe that under proper conditions, the production of rain by the dry ice method can become a routine procedure. Our biggest problem now is with proper cloud conditions to be able to drop the rain where we want it, when we want it.

In conclusion, the writer would like to express his sincere thanks to all of those who have taken part in this work, and chiefly to the New Orleans Weather Bureau and the Naval Air Station for their splendid cooperation in allowing us to take rather large quantities of dry ice on very short notice in order to have enough ice to properly conduct this work.

PRESENT AND FUTURE PROSPECTS OF MECHANICAL CANE PLANTING IN LOUISIANA

by M. V. Yarbrough, General Manager, Young's Industries, Inc., Youngsville, La.

For presentation and discussion at the meeting of the Agricultural Section of the American Society of Sugar Cane Technologists, Houma, Louisiana, August 4, 1948.

To date there has been no commercial planting of sugarcane by machine in Louisiana. Predictions on the subject can be based only on opinion. The first step in the preparation of this paper was to secure opinions on the subject from a representative cross-section of persons engaged in cane growing in Louisiana.

The next step was to determine from the opinions expressed the best possible answers to two questions:

1. What would Louisiana cane growers expect a cane planting machine to do?

2. What advantage, as compared to present planting methods, would be expected to be derived in order to justify mechanical planting?

Opinions on the subject were expressed by twenty-five persons, including Dr. Taggart and Dr. Arceneaux, out of thirty to whom the following questionnaire was sent.

QUESTIONNAIRE

MECHANICAL CANE PLANTING IN LOUISIANA

Please number from "1" upwards each of the following possible advantages, as compared to present cane planting practices, which you feel should be sought for in mechanical planters. Number the most important item "1", the next in importance "2", and so on up. If you think of other advantages

you feel should be sought, please describe on the blank lines and then rank the order of importance of all items on your list. If you feel any "possible advantage" listed to be unimportant as compared to present planting methods, please rank all such items "O".

RANK	POSSIBLE ADVANTAGES
( )	More precise and uniform spacing of seed lengthwise in furrow to reduce gaps in stands.
( )	More precise and uniform spacing in seed lengthwise in furrow to effect economy in amount of seed required.
( )	Confine covered seed to narrower limits within the furrow to permit narrower off-bar and/or reduce mother cane destruction in off-bar operation.
( )	Provide means to compact, to a considerable extent, a controllable amount of dirt around, between, and on top of the seed pieces after planting in the furrow and before the final covering operation with presently used covering tools.
( )	Reduce cost of planting.
( )	Reduce time required for planting using same amount of labor as presently.
( )	Reduce amount of labor required to plant in same length of time as presently.
( )	Better control of planting furrow depth as referred to water furrow bottom.
( )	Better pulverization of dirt immediately surrounding and contacting the covered seed piece.
( )	Handle seed cane less roughly than at present.

No individual opinions expressed will be disclosed.

The volume and tenor of the response indicates a keen and general interest in the subject. Many not only returned the completed questionnaire but supplemented it by letter. The combined 1946 sugarcane production of those who expressed opinions exceeded one million tons. The writer wishes to thank all of those who expressed their opinions on the subject.

The consensus of expressed opinion is overwhelming that the advantage to be sought from mechanical planting is increased yields of sugarcane. Reduction in cost of planting is considered of secondary importance to such an extent that many expressed the opinion that, even if mechanical planting proved more costly, the increased planting cost might be justified by increased yields.

It is impossible to accurately determine and express numerically in a single tabulation the relative importance of all possible advantages expected from mechanical planting as reflected by twenty-five expressions on the subject. For those who might be interested, however, the best attempt possible was made.

In this attempt a numerical weight, equal to the rank in importance attached to each possible advantage in each expressed opinion, was assigned to each advantage. Total numerical weight for each advantage was determined and this total weight was divided by the total number of opinions expressed. The resulting average numerical weight in the consensus of opinion for each advantage is shown under "Average Rank" in the tabulation which follows. As would be expected some persons ranked two or more advantages of equal importance in their opinions. Had all individual opinions ranked any single advantage greatest in importance, its "Average Rank" would, on this basis, have been 1.00. Also in the tabulation which follows, under column headed "ranked first", is shown the total number of opinions in which each advantage was ranked first in importance.

CONSENSUS OF TWENTY-FIVE OPINIONS

Possible Advantage	Average Rank	Ranked First
Precise spacing lengthwise to reduce gaps in stands	1.92	15
*Precise depth of coverage with soil	2.00	0
Precise spacing lengthwise to effect seed economy	3.96	0
**Close furrow immediately after opening	4.00	0
Controlled compacting of soil around seed	4.24	3
Control of planting furrow depth	4.28	4
Narrower spacing of seed in furrow	4.84	1
Pulverization of soil contacting seed	5.40	1
Reduction of planting costs	5.44	2
Reduction in time required to plant crop	5.60	2
Reduction in labor required	6.28	2
**Uniform row spacing for multiple row cultivation	7.00	0
Handle seed cane less roughly	7.36	1
**Ability to plant crooked cane	11.00	0

*Only two expressed opinions on this advantage

**Only one expressed opinion on each of these advantages.

On all other possible advantages listed above, opinions were expressed by all of the twenty-five persons.

In order to completely round out the consensus of opinions expressed, I quote some of the comments contained in letters from thirteen of the twenty-five persons who expressed opinions.

1. "It may be a mechanical planter will eventually provide the improvement that is greatly needed. It seems to me that the most important consideration is to reduce gaps in stands of cane. It is tempting of course to rate "reduced cost of planting", No. 1, for cost, now with the decreased price of sugar has become all important, however, as compared with better stands, even that, I think, is

secondary, ---frequently we have good stands and bad stands of the same variety of cane planted in lands of like quality. A mechanical planter might give us a more uniform planting than is possible under our present conditions."

2. "Mechanical planting will allow a better control of length of seed piece, therefore insuring better germination due to the flow of Auxite to the eyes. It will also permit hot water treatment and treatment with various chemicals for disease control by lessening the volume of seed."

3. "In my opinion the soil should be WELL prepared before the mechanical planter goes into the field. Mechanical planters might make possible the treatment of seed pieces with disinfectants, insecticides or fungicides."

4. "Seed bed preparation must precede the planting proper."

5. "The problem will be to mechanically handle large amounts of seed necessary in Louisiana."

6. "Most of the advantages could be secured by means of the equipment and labor now in use but at too high a cost."

7. "All of the possible advantages are certainly important. In general we feel that the most important group of advantages would be that tending to improve or increase the stand of cane. Labor and cost saving would be very important also, but in our opinion, subordinate to increasing the yield of cane."

8. "Wider furrows preferable to cover seed pieces individually.

9. "Cut seed into 3 eye seed pieces. The narrower the planting furrow, the better. Even if costs are not reduced the saving of time and labor is the great factor. Perfect seed bed is always desirable. Handle seed by belt to save bruising."

10. "Use same amount of labor to strip cane so that mechanical planter would work more efficiently and leave Johnson Grass seed in the seed cane plots. Plant more cane in the summer season, stripping well and using less seed in period of August 2nd to August 21st. A machine could, in all probability, plant all of our cane in this period."

11. "Some means should be devised to plant clean cane. Cutting cane in small pieces with ends untreated may cause a high percentage of rot, especially in Fall plant."

12. "Plant clean cane free from Johnson Grass is very important. Cutting seed into pieces is dangerous in Fall planting and is objectionable in mechanical planting."

13. "I believe it (mechanical planting) will slow down planting rate and possibly increase labor costs."

Now, having set forth the consensus of opinion as to what would be expected of a Mechanical Cane Planter in Louisiana and the advantages expected to be obtained, I will undertake to predict, "Present and Future Prospects of Mechanical Cane Planting in Louisiana". Although these predictions are made with the consensus of expressed opinions fully in mind, the predictions are strictly my own. Should time eventually prove any of these predictions correct, they are correct only because of the assistance, cooperation and information furnished me by those who expressed their opinions and desires with respect to mechanical planting.

I believe the Prospects for Mechanical Cane Planting in Louisiana to be about as follows. A mechanical planter can be built which will:-

1. Open a planting furrow with perfect control of level of furrow bottom as related to level of water furrow bottoms, but ONLY if soils have been properly prepared and planting rows properly drawn AHEAD of the cane planter.

2. Deposit full length seed cane in the furrow, precisely spacing seed pieces lengthwise in the furrow.

3. Deposit the seed at any reasonably desired rate of planting and in any reasonably desired pattern at any given rate - such as two lines and a lap - two lines, no laps, with broken joints - two lines, desired gaps between stalks in each line, with broken joints - etc.

4. Confine lines of seed in furrow to narrowest width possible, according to bend in stalks, and with seed in the two lines still largely out of contact with each other and soil between.

5. Initially cover the seed with a limited and controlled amount of soil.

6. Compact this soil of initial coverage around and on top of the seed to any desired reasonable degree.

7. Plant reasonably crooked seed cane full length without breaking.

8. Machine will be limited to single row planting.

9. Forward speed of machine will probably be too slow to permit use of discs for opening or closing planting furrow.

10. Tools on planters for opening and partially, or initially, closing the planting furrow will probably consist of, respectively, a highly modified middle buster and pitched scraping blades.

It is my opinion at present, and please bear in mind that opinions are always subject to change, that:-

1. A planting machine will be unable to effect any preparation of the soil. Thorough soil preparation and proper row drawing must precede the planter.

2. Final covering, after the initial limitea covering and compacting by the planting machine, can best be accomplished in another operation with discs equipped with pitched depth control wheels running in the water furrows and, if desired, with a striker behind to strike excess dirt from row.

3. The first few feet from headland to quarter-drain and the last few feet from quarter drain to headland will best be planted by hand - seed for this to be thrown off of the planting machine onto the headland while planter is crossing or turning on headland.

4. All coverage of seed between headlands and quarter drains to be accomplished not by the cane planter but by the discs in the "final covering" operation immediately following the cane planter and its initial partial covering and compacting.

5. Rows will have to be planted and initially covered by the planting machine and then finally covered with discs right through all cross drains. Drain plows with two coulters ahead will then cut out 12 to 14 inches of seed in the drain plowing operation.

6. Seed cane will probably be handled as roughly as at present.

7. The total cost of planting will not be appreciably reduced even if possible seed economy be considered.

8. To secure full advantage of precise spacing of seed lengthwise in the furrow and any attendant seed economy will surely necessitate at least the proper topping of the seed by hand, and carefully. This will probably justify cutting seed completely by hand and also stripping. I know that both Fall and Spring FULL emergence of cane is very appreciably accelerated by stripping the seed. Note the use of the words "full emergence", that is emergence of all mother shoots which will show up. I know also that unless seed be PROPERLY hand topped, precise spacing of "seed" could readily result in either gaps in the stands of cane or the continued use of more "seed" than necessary. Some of the "seed" in machine average topped cane does not contain good eyes unless the machine topping is so low as to cut off and thus waste true "seed" containing good eyes.

9. All seed cane planted full length by machine will still have to be handled at least one time by hand.

10. As yet I am far from convinced that seed treatments as yet undiscovered may ever make it possible to safely plant 2 or 3 eye cut seed pieces in Louisiana. Our long periods of winter dormancy demand much from the seed treatment if short seed pieces are to be relied upon.

With regard to widespread use of mechanical planters in Louisiana, I predict:

1. Unless and until mechanical planting will have proven positively to result in definite increases of 10% or more cane produced per acre, both plant and stubble, mechanical planters will not be widely used.

2. To determine definitely whether the results obtained justify their continued use, at least 3 years' time will be required after the first planters are used commercially.

3. Even after that, the trend to mechanical planting generally will be relatively slow. Planters will cost money. Their successful use, if at all possible, will necessitate a completely new and different organization and set up both of man-power and other equipment aside from the cane planters proper use in the entire seed-gathering, seed transportation, and seed handling operation. Seed will have to be loaded flat onto chain or rope slings in tractor cart beds provided with a center wall across the cart. Bundles in each pair of slings will have to be restricted to a maximum of 1200 to 1500 pounds of seed, probably 4 bundles of seed in four pairs of slings in each cart. Then these bundles will have to be unloaded by dragline or small portable cranes and stacked, still in the slings, alongside the crane on a headland, near the fields being planted, to be then picked up and deposited on the planter by the crane as required. Much tractor and cart time devoted to seed transportation from seed field to planting field will be saved, provided only however that a fleet of probably four or more planters be in operation.

In view of the apparent general interest in mechanical planting and the belief and hope that cane yields may be increased thereby, I feel certain that there will soon be activity in the attempt to develop cane planters. We are building a machine at Youngsville now and hope to make extensive plantings with it this Fall. However, unless mechanically planted fields produce considerably more cane per acre than those planted under present methods, I anticipate no reason to justify the construction of any more machines unless it be for the purpose of substantially reducing the total time required to plant our crops with the same labor and tractor equipment now in use.

I personally would consider it a big advantage it we could accomplish our planting in 10 days to two weeks. But enough planting machines to do this could cost us as much as $20,000 to $25,000, if indeed the machine works satisfactorily. I anticipate no reduction in total planting costs, including seed value. Accordingly, so far as we can foresee at the present time, justification of mechanical planting in our case depends largely upon improved cane yields.

At this time I desire to thank Mr. Ramp for a half day of his time devoted to a discussion of this subject a few weeks ago. This discussion was of much assistance to me in preparing this paper. Mr. Ramp has given more thought to mechanical cane planting in Louisiana than have any of the rest of us. He has not only built some machines, but has used them at the Houma Station. Certainly no one else present is as well fitted as he to lead the discussion of the subject of mechanical cane planting to follow this paper.

If there be any questions regarding the subject matter of my paper, I will be glad to attempt to answer them at this time. After which the subject will be turned over to Mr. Ramp who has kindly consented to lead the general discussion of the subject and for which we all thank him.

SUGAR CANE - PASTURE ROTATION

by R. J. Jeansonne, District Conservationist
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Presented at the meeting of the Agricultural Section, Houma, La., Aug. 4, 1948.

The tendency in farming has been to devote a greater number of years in the rotation to the production of soil depleting cash crops, than to the growing of legumes, grasses and other soil improving crops until forced by reduced yields to resort to longer periods of legumes or legumes and grasses in order to maintain production.

It is a well established fact that land devoted to the production of cash crops under continuous clean cultivation will become depleted unless adequate quantities of plant food are restored periodically. Soil depletion studies conducted at the Louisiana Sugar Experiment Station bring that out very clearly.

An experiment begun on land that had been in sod for a number of years and which was considered highly fertile, produced 45.58 tons of sugar cane per acre the first year. After fifteen years of growing sugar cane and corn without returning organic material to the soil, except for that present in cane trash (after burning) and residue from roots and corn stalks, sugarcane yields dropped to 24.36 tons per acre; a 46 percent decrease in the period of 15 years.

Specialists point out that under continuous clean cultivation soil becomes depleted of organic matter, whereas under sod it becomes enriched in organic matter.

Organic matter, among many other things, is a source of plant food. Soils high in organic matter, according to authorities on the subject, are more productive than soils low in organic matter.

The use of sod crops in rotation with cultivated crops has long been recognized as a desirable and practical means of maintaining high fertility levels and desirable soil conditions. Experiences of old agriculture in Europe and results obtained from older experiment stations

in this country substantiates that fact.

Several farmers in the sugar cane section have told us that sugar cane following pasture produced greater yields than sugar cane grown on similar land where the conventional rotation of three years sugar cane and one year soybeans was followed. A 76-acre field on Conway Plantation, near Burnside, Louisiana, was put into pasture, according to Mr. Edgar J. Waguespack, part owner and manager, because it was so badly run down and infested with Johnson grass that it hardly produced 10 tons of sugar cane per acre. After three years in pasture and one year in corn and cowpeas, in which the cowpeas were turned under for green manure, first year cane in 1947 produced an average of 35 tons per acre. Johnson grass infestation was reduced to practically nothing.

The results obtained on Conway Plantation may be an extreme case, but it does give some indication of the possibilities in a sugar cane - pasture rotation. Other farmers have had experiences similar to that of Mr. Waguespack, although not so pronounced.

M. L. Marquette, manager of South Coast Corporation property in St. Mary Parish, estimates a five ton increase in one plot and seven tons on another plot where sugar cane followed pasture on the Coteau Unit. J. K. Darnall estimates an increase of five tons on Ivanhoe Plantation; W. B. Smith estimates an increase of five tons on Idlewild Plantation, etc.

I present the above facts as some of the reasons for considering the use of sod in rotation with sugar cane. I do not claim a sugar cane - sod rotation to be the most desirable for all farms in the sugar belt, for on some, because of their individual characteristics, it would be almost physically impossible to apply, but I do believe it has a place and should be given careful consideration.

I would like to present for your consideration a sugar cane - sod rotation that has been worked out by technicians of the Soil Conservation Service. In working out this rotation we kept in mind the fact that sugar cane is the principal crop and tried to devote as much land as possible to sugar cane each year and still work in sod crops in periods of sufficient length of time to justify the cost of application.

This rotation covers a period of 12 years consisting of one cycle of pasture and two cycles of sugar cane. It

devotes 1/2 of the cropland to sugar cane; 1/4 to pasture; and 1/4 to corn and soybeans, soybeans alone, and Alyce clover.

The rotation is as follows:

1st year -	Alyce clover (seeded in June) (overseeded in fall with clovers and grasses for pasture)
2nd year -	1st year pasture
3rd year-	2nd year pasture
4th year -	3rd year pasture
5th year -	Corn and soybeans (followed by sugar cane and winter legumes planted in the fall)
6th year -	1st year sugar cane
7th year -	2nd year sugar cane
8th year -	3rd year sugar cane
9th year -	Soybeans (followed by sugar cane and winter legumes planted in the fall)
10th year -	1st year sugar cane
11th year -	2nd year sugar cane
12th year -	3rd year sugar cane

Alyce clover is used in the first year of this rotation to allow farmer ample time to level his land following sugar cane before going to a sod crop. It would probably crowd farm operations too much to prepare land coming out of sugar cane in time to seed to pasture that fall. Alyce clover seeded in June could be used for either hay or grazing depending on the needs of the farmer. The land would then be level in preparation for seeding pasture clover and grasses the following fall.

Fallow plowing could be substituted for Alyce clover to turtle back or ridge the land and to reduce Johnson grass infestation should that be desirable.

Corn and soybeans are used following pasture as a crop to be cultivated to tear up the sod and destroy clovers and grasses before going to sugar cane. Soybeans could be planted alone if there is no need for corn on the farm.

To apply the 12-year rotation, the farm or plantation should be divided into 12 units as near equal in size as practical.

The rotation should be applied progressively over a period of years to prevent too much disturbance in farm operations.

The ideal way would be to start the rotation in one field each year taking 12 years to get the whole farm under the rotation system. By following this route, the farmer would know by the end of the sixth year what he can expect from this rotation before going all out for it. By then he will be taking a field out of pasture for each field he puts into pasture.

The chart on the following page shows how the rotation could be applied progressively over a period of twelve years. You will note from the chart that at the end of twelve years the farm would be devoted to crops as follows: 1/2 to sugar cane; 1/4 to pasture; 1/12 to Alyce clover; 1/12 to corn and soybeans; and 1/12 to soybeans alone. This balance would be maintained thereafter as long as the rotation is followed. Each year there would be an equal amount of plant cane, first year stubble and second year stubble. There would also be an equal amount of first, second and third year pastures each year. You will note right off that such a system would tend to equalize operations and revenue each year.

Natural questions to arise are, what returns might be expected under such a rotation system, and how do these returns compare with returns from the conventional rotation of three years sugar cane and one year soybeans?

ESTIMATED PER ACRE RETURNS OVER A PERIOD OF TWELVE YEARS

	Sugar cane yield	Years in sugar cane	Gross returns			Expenses	Net returns	Net returns per acre per year
			Sugar cane	Beef	Hay & seed			
4-Yr. rotation: 3 years sugar cane and 1 year soybeans	18 T	9	$1296.00	0	0	$551.58	$744.42	$62.04
12-Yr. rotation: 6 years sugar cane, 3 years pasture, 2 years soybeans, 1 year Alyce clover. Estimated 5 tons per acre increase in sugar cane yields over 4 year rotation	23 T	6	$1104.00	$162.00	0	$432.90	$833.10	$69.43

You will note in the 4 year rotation that the gross returns are greater than in the 12 year rotation, but expenses are likewise greater. The net returns, therefore, are greater in the 12 year rotation.

This is brought about because in the 4 year rotation the expense of producing 9 years of sugar cane and 3 years of soybeans in a 12 year period is greater than producing 6 years of sugarcane, 3 years pasture, 1 year Alyce clover, and 2 years soybeans, even in considering the cost of fencing in converting from the 4 year rotation to the 12 year rotation.

CHART SHOWING HOW THE ROTATION COULD BE APPLIED PROGRESSIVELY OVER A PERIOD OF 12 YEARS

Year	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10	Field 11	Field 12
1949	Alyce clover											
1950	1st yr. pasture	Alyce clover										
1951	2nd yr. pasture	1st yr. pasture	Alyce clover									
1952	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover								
1953	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover							
1954	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover						
1955	2nd yr. cane	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover					
1956	3rd yr. cane	2nd yr. cane	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover				
1957	Soy-beans	3rd yr. cane	2nd yr. cane	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover			
1958	1st yr. cane	Soy-beans	3rd yr. cane	2nd yr. cane	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover		
1959	2nd yr. cane	1st yr. cane	Soy-beans	3rd yr. cane	2nd yr. cane	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover	
1960	3rd yr. cane	2nd yr. cane	1st yr. cane	Soy-beans	3rd yr. cane	2nd yr. cane	1st yr. cane	Corn & beans	3rd yr. pasture	2nd yr. pasture	1st yr. pasture	Alyce clover

Another reason for returns being greater in the 12 year rotation is due to the estimated increase in yields of sugar cane.

The principal drawbacks to the 12 year rotation, would be the necessity of dividing the farm or plantation up with fences and the initial investment that would be required to stock the farm with livestock. Farms containing livestock are in a better position to adopt such a rotation. Another possible disadvantage may be in supplying water for livestock. Unless fencing could be planned to permit watering from existing facilities, it may be necessary to install additional watering facilities.

Many farmers are hesitant in adopting such a rotation because of the uncertainty of acreage allotments. They are afraid that should they reduce their sugar cane acreage to apply such a rotation, that their acreage may again be reduced if acreage quotas are applied. It would be a great help if this point could be cleared and permanently settled.

Some of the advantages of the 12 year rotation on the other hand, in addition to the possibilities of increasing the net farm income, are that it would tend to diversify farming. Should sugar cane prices drop out of proportion to other crops, there would be another crop to fall back on.

A rotation of sod and cultivated crops would also help to maintain high fertility levels over a long period of time.

The 12 year rotation has been adopted on Idlewild Plantation near Patterson. W. B. Smith, manager, plans to use sod for seed production though, instead of for grazing.

Spencer G. Todd has adopted a deviation of the 12 year rotation on his plantation near Calumet in St. Mary Parish. His is a ten year rotation. He eliminates one year of sugar cane in the second cycle using only plant cane and first year stubble. He also plans to either eliminate one year of pasture or to eliminate corn and soybeans following pasture and go direct from pasture to sugar cane.

There are several deviations that could be made in the 12 year rotation to fit the individual farms. It may be possible on some farms to go direct to pasture from third year sugar cane without planting Alyce clover. Alyce clover may be desirable, however, in a livestock program as a source of hay.

Farmers who may prefer not to invest in livestock

immediately could use the pastures or sod to produce seed until they acquire livestock. This would also eliminate immediate fencing. If he harvests all vegetation for hay though, he should not expect much increase in organic matter content.

A good system of crop rotations is one thing, but it should not be depended upon entirely to maintain or improve production. Drainage, cultivation, fertilization, crop varieties, weed control, insect and disease control, and overall farm management, all play an important part. Only by combining all these can we hope to attain the desired goals.

A METHOD OF MEASURING THE QUANTITY OF VIABLE JOHNSON GRASS SEED IN THE SOIL

by Leo P. Hebert, Assistant Agronomist, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture

Presented at the Annual Meeting, Houma, La., Feb. 12, 1948

Eradication of Johnson grass presents a twofold problem, viz: (1) the destruction of established plants and (2) prevention of reinfestation from seedlings. Fallow plowing under appropriate conditions may be expected to dispose of the bulk of the rhizomes within one or, at the most, two years. After that, possibility of reinfestation from seedlings is the important consideration, therefore there is need of a method whereby the quantity of viable seed remaining in the soil may be accurately and quickly determined. This report briefly summarizes some of the results obtained with a method which seems to offer considerable promise in this connection.

A field heavily infested with Johnson grass on St. Delphine Plantation near Plaquemine which had been under fallow plowing for approximately 2 months was sampled in the following manner: At each of 9 locations, 4 borings were made with an 8-inch auger to include each of the following soil layers separately - 1-6 inches; 6-12 inches; 12-18 inches. The four samples of each layer at each station were composited for germination tests.

The 27 separate samples of soil were brought to Houma and placed in flats in the greenhouse and kept moist for a period of 43 days at maximum temperatures ranging from 105° to 115° F. Table 1 gives average germination counts by layer and by period during the 43 days. At the end of each of the 5 periods specified in the table all Johnson grass plants were pulled, origin of each verified (seed or rhizome) and number of seedlings noted. With a little experience there is no difficulty in identifying seedlings of Johnson grass.

As shown in table 1 each composite sample of soil

Our results to date, show that somewhere between 1 and 1-1/2 pounds of chlorate applied to 100 square feet of infested land achieves an excellent kill. The duration of this kill has not yet been determined, but it is apparent from examination of the roots that any regrowth will be from seedlings. Where a 100% kill is not obtained by the first chlorate treatment, it is quite possible that a second spot application to surviving plants, rather than a complete overall second treatment, may complete the kill and yet economize on the amount of chlorate needed. We have no information yet as to whether two general applications of 3/4 pound might not be better than one application of 1-1/2 pounds but will have the information by this fall. We believe that the chlorate treatment in normal years can not be expected to prevent growth of new seedlings in the treated area and have in mind further trials whereby 2, 4-D is added to our chlorate solutions and where 2, 4-D is applied at some date after the chlorate application in order to see whether the germination of seedlings can be inhibited or prevented.

On the basis of a 1-1/2 pound application for 100 square feet and using the figures of 7, 000 square feet of marginal land per acre of cane, the cost of chlorate to poison the marginal land in conjunction with one acre of growing cane amounts to $8.92. Add to this cost of calcium chloride which is 1-1/2¢ per pound delivered or $1.05 representing a total material cost of about $10.00. We have no figures on the cost of application but believe that application can be achieved at the same labor cost as ditch bank burning.

In summary, I would say that our results are not yet conclusive and that the cost appears somewhat high. We do not yet know whether chlorate application will be necessary every year but expect that it will not. Chlorate poisons constitute a serious fire hazard and either require special equipment or extreme care in washing equipment directly after use. For the immediate present, we think chlorate looks good since we know of no other more satisfactory or cheaper means of obtaining the results which we have seen on our tests. We fully expect that within the next few years much superior means will be discovered for eliminating the source of Johnson grass re-infestation on the marginal lands surrounding our cane fields. Until that time, however, and if our present tests continue to look promising, as they now do, our company will undoubtedly go in for general chlorate application next year.

Table 1. Germination of Johnson grass seed from different depths below the soil surface. Samples taken on St. Delphine Plantation May 29, 1947. Germination period May 29 - July 10, 1947. Greenhouse temperature, daytime high 105-115°F. No record of minimum temperature.

Period of germination (days after planting)	Number of germinating plants from sample area of 201 square inches Average of 9 soil samples			
	From layer 0-6 inches below surface	From layer 6-12 inches below surface	From layer 12-18 inches below surface	3 layers (0-18 inches) below surface
0 - 11	1.6*	10.4	6.4	18.4**
12 - 18	.9	10.0	8.2	19.1
19 - 27	.3	6.6	9.4	16.3
28 - 35	.1	.7	.8	1.6
36 - 43	0	.2	.7	.9
Total	2.9***	27.9	25.5	56.3

* Standard error of this and comparable mean values 1.68
** " " " " " " " " 2.91
*** " " " " " " " " 5.99

covered an area of 201 square inches. In the total of the 3 layers such a sample gave an average germination of 56.3 seedlings or, based upon the total of 1809 square inches of soil sampled, the equivalent of 1,756,963 seedlings per acre.

It will be noted that the great bulk of seedlings came from depths of more than 6 inches. Many of the seeds at lesser depths had no doubt already germinated. The importance of deep plowing during the fallow period to expose deeply buried seed and accelerate germination is clearly indicated.

Soil samples from the 0-6 and the 6-12-inch layers gave the highest germination during the first period whereas the sample from the 12-18-inch layer gave the highest germination in the third period (from 19th to 27th day). This suggests a certain degree of dormancy among deeply buried seeds. To what extent this may be a factor in prolonging the period of soil contamination from buried seed remains to be determined. Samples of soils used in this series of tests have been preserved and additional germination tests will be made at a later date.

The value of this method as a quick means of determining the extent to which a given soil area may be contaminated with Johnson grass seed will depend on how completely the germination takes place under exposure to greenhouse conditions. The high counts observed in the experiment cited would seem to indicate that a considerable percentage if not all of the viable seed may have germinated during the 43-day period of observation. Practical advantages of such a method to determine residual quantities of viable seed and depth at which found in the soil following eradication treatments are obvious.

TEST OF CYANAMID FOR KILLING SUGARCANE FOLIAGE IN ADVANCE OF HARVEST

by George Arceneaux, Senior Agronomist, and Lester G. Davidson, Associate Chemist, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture[1/]

Presented at the Annual Meeting, Houma, La., Feb. 12, 1948

Detrashing of sugarcane by burning is now considered standard practice in Louisiana. Ordinarily the cut cane must remain in the field several days before the foliage becomes sufficiently dry to burn well. The practice has proved reasonably satisfactory under dry conditions, but in case of rain the cane may have to be held over for prolonged periods or sent to the factory in a trashy condition. Therefore the harvest operation would be greatly simplified if some satisfactory means could be found of inducing the foliage to dry out sufficiently to permit burning while the cane is still standing. This report briefly summarizes results of preliminary studies on the use of cyanamid dust as a means of killing sugarcane foliage prior to cutting.

On the night of October 13, 1943, applications of finely pulverized cyanamid were made by airplane on different blocks of a field of Co. 290 on Southdown Plantation at the following rates per acre (pounds): 30; 60; 90; Check (no treatment). Each block consisted of one "cut" of approximately 1-1/2 acres. Untreated "cuts" between experimental blocks served as buffers. The identical treatments were repeated on a nearby field of C. P. 29/320.

Effects of the dusting on sugarcane foliage were, on the whole, disappointing. Blades of the fully exposed topmost leaves were severely scorched by the treatment and dried up rather promptly.

1/ The authors are indebted to The American Cyanamid Company and its representative, Mr. H. R. Kelly, and to Realty Operators, Inc., and its representative, Mr. Elliott Jones, for making available necessary facilities for this experiment and for valuable cooperation in conducting the experimental work.

But the great bulk of the remaining green foliage showed only minor injury or no apparent effect from the treatment. There was a perceptible increase in extent of leaf damage with an increase in rate of dusting but even at the highest rate the treatment did not greatly improve the condition of the trash for burning.

In order to determine the possible effect of the various treatments on subsequent accumulation of sucrose and other changes in the composition of the sugarcane juice, all the cane in the experiment was allowed to stand for a period of approximately 1 month. Table 1 gives results of analyses of juice from samples of cane taken at weekly intervals from each of the treatment blocks over the period October 15 to November 11, inclusive. Each value shown is the average of 3 analyses of juice from separate samples of 25 stalks each. The samples of sugarcane were crushed by means of a 3-roller mill which gave an average juice extraction of 63.2% in the case of Co. 290, and 58.3% in the case of C. P. 29/320. There was no significant difference in rate of juice extraction at any time between treated and untreated cane. Table 2 gives a summary of data presented in Table 1.

In the course of 4 weeks juice of untreated cane showed substantial gains in sucrose content (Pol.), Brix, and purity. Corresponding changes in the case of dusted cane ranged from slight increases to slight decreases. Untreated plots showed an average indicated gain of 21.8 pounds of sugar per ton of cane, as compared with an average indicated gain of 7.5 pounds in the case of plots dusted at the 30-pound rate, and slight apparent losses in the case of plots dusted at the rates of 60 and 90 pounds per acre, respectively.

Within limits of ordinary experimental variations, trends as summarized above were reasonably well maintained from date to date with each of the two varieties tested.

The percentage of invert sugars in sugarcane ordinarily decreases as maturity advances. Results shown in Tables 1 and 2 are not sufficiently consistent to indicate a clearly significant interference with this process as a result of dusting but it is interesting to note that dusted plots, on the average, showed a somewhat lesser decrease in invert sugar content than was observed with the controls.

In translating results of this research to terms of ordinary procedure it must of course be recognized that sugarcane in the

experiment was subjected to the effects of the treatment over a much longer period of time than would be commonly required in the practical utilization of a leaf killing agent for pre-harvest burning. With a treatment as effective as a killing freeze for instance, the trash should ordinarily reach a stage of dehydration permitting satisfactory burning within 5 to 8 days. In this experiment untreated cane gained 21.6 pounds of recoverable sugar per ton over a period of 27 days, or an average gain of 0.8 pound per day. Eliminating such a gain over a period of 5 to 8 days would involve a sacrifice of 4 to 6 pounds of sugar per ton of cane.

In addition there is reasonably good evidence that the harmful effects of the treatment increased with an increase in severity of leaf damage. Therefore a treatment causing enough damage to the foliage of standing cane to permit later satisfactory burning might be followed by a considerable drop in available sugar. This together with the sacrifice of the normal gain to be anticipated between time of treatment and time at which the foliage becomes sufficiently dry to burn could add up to a substantial loss in recoverable sugar. It would seem important, therefore, to examine critcially any new scheme which might be employed in killing foliage to facilitate pre-harvest burning.

Table 1. Effect of foliage applications of cyanamid dust at different rates per acre on sucrose accumulation and other changes in juice composition.

Date of Sampling	Tests of Co. 290 Rate of application (pounds) 0 (Check)	30	60	90	Tests of C. P. 29/320 Rate of application (pounds) 0 (Check)	30	60	90
Oct. 15	10.66	9.94	10.47	11.30	14.28	14.16	14.51	14.93
Oct. 21	10.18	9.77	10.17	10.26	14.94	14.02	13.70	13.79
Oct. 28	10.87	10.28	10.01	10.66	14.49	14.51	13.68	13.63
Nov. 4	12.09	10.11	10.05	10.69	15.11	14.50	14.28	14.39
Nov. 11	12.02	10.45	10.63	11.29	15.50	14.46	13.90	14.70
				Brix of crusher juice				
Oct. 15	14.34	14.03	14.33	14.69	17.22	17.29	17.69	17.27
Oct. 21	13.84	13.58	13.82	13.67	17.39	17.04	16.69	16.42
Oct. 28	14.69	14.11	12.97	14.11	17.88	17.55	16.82	16.46
Nov. 4	15.29	14.06	13.74	13.99	17.79	17.51	17.22	17.01
Nov. 11	15.62	14.36	14.06	14.52	17.99	17.39	16.82	17.46
				Apparent purity of crusher juice				
Oct. 15	74.34	70.85	73.06	76.92	82.93	81.90	82.02	86.45
Oct. 21	73.55	71.94	73.59	75.05	85.91	82.28	82.08	83.98
Oct. 28	74.00	72.86	77.18	75.55	81.04	82.68	81.33	82.81
Nov. 4	79.07	71.91	73.14	76.41	84.94	82.81	82.93	84.60
Nov. 11	76.95	72.77	75.60	77.75	86.16	83.15	82.64	84.19

Table 1 (continued)

	Invert sugars percent crusher juice							
Oct. 15	1.81	2.09	1.85	1.46	0.88	0.92	0.88	0.88
Oct. 21	1.98	2.07	1.86	1.47	0.90	1.04	1.04	0.94
Oct. 28	1.80	1.63	1.73	1.75	0.73	0.93	1.04	0.92
Nov. 4	*	*	*	*	*	*	*	*
Nov. 11	1.63	1.87	1.80	1.36	0.77	0.94	1.10	0.80
	Indicated yield of 96^{o} sugar per ton of cane (pounds)**							
Oct. 15	148.1	133.8	143.9	160.4	195.6	192.7	197.6	209.0
Oct. 21	140.5	132.9	140.4	143.4	208.5	191.2	186.6	190.2
Oct. 28	150.6	141.0	142.4	149.7	196.0	198.5	185.4	186.6
Nov. 4	174.4	137.4	138.2	151.1	209.6	198.5	195.6	199.2
Nov. 11	170.7	143.2	149.3	161.3	216.6	198.4	190.1	203.0

*Not determined.

**Winter-Carp-Geerligs formula, simplified, assuming varietal milling factors as per Arceneaux, G., Sugar Bulletin, Vol. 23, No. 21, pp. 186-191, August 1, 1945.

Table 2. Effect of foliage applications of cyanamid dust on sucrose accumulation and other changes in crusher-juice composition between October 15 and November 11, 1943.

Rate of cyanamid dust application per acre (pounds)	Increase (+) or decrease (-) between Oct. 15 and Nov. 11. (Average of two varieties)				
	Percent Sucrose	Brix	Apparent purity	Percent invert sugars	Indicated yield of 96° sugar per ton of cane (pounds)
0 (Check)	+1.29	+1.02	+2.92	-0.14	+21.8
30	+0.40	+0.21	+1.58	-0.10	+ 7.5
60	-0.22	-0.57	+1.58	+0.08	- 1.0
90	-0.12	+0.01	-0.71	-0.09	- 2.5

PRELIMINARY TESTS WITH AMMONIUM TRICHLORO-ACETATE AS A HERBICINE

by T. C. Ryker, E. I. DuPont de Nemours & Co., Inc., in cooperation with the Louisiana Agricultural Experiment Station

Presented at the Annual Meeting, Houma, La., Feb. 12, 1948

Plots of several soil types heavily infested with Johnson grass were treated with ammonium trichloroacetate (ATA) in comparison with Atlacide. In two of the tests Bermuda grass was also present. The ATA was used at rates of 54, 109, 218, 327 and 436 lbs. to the acre dissolved in 400 gallons of water. The Atlacide was applied at rates of 436 and 654 lbs. in 400 gallons of water per acre. The materials were applied on June 13, June 16, July 2, August 26, and September 26, 1947.

Good control (95 to 100 percent kill) of Johnson grass was obtained with ATA at rates of 218 lbs. or higher. The kill with 109 lbs. per acre varied from 90 to 100 per cent in the various tests and was comparable to the 436 lb. application of Atlacide. The 654 lb. application of Atlacide gave practically complete control of Johnson grass where properly applied. Wherever Bermuda grass was present in the plots, 109 lbs. or more of ATA to the acre gave good control of this weed. Neither Johnson grass nor Bermuda gasss was killed satisfactorily with the 54 lb. rate of ATA.

When the moisture content of the soil was moderately high, equally good results were obtained when the solutions of ATA were applied on mowed or unmowed Johnson grass. Under the dry conditions which prevailed in August and September better control was obtained on the unmowed plots. However, there was very little germination of rhizomes from mowed or unmowed plots when placed in moist chambers. in November.

To determine the action of ATA on Johnson grass seedlings a test was made in the fall of 1947 in a field in which

a heavy stand (700 to the square yeard) of plants two to four inches high was present. Three rates of application, 27, 41. and 54 lbs. per acre were used. Both 30 and 100 gallons of water per acre were used with each rate of application. The two higher rates killed nearly all seedlings while the 27 lb. rate killed 87 per cent of the seedlings present in the plots. There was no difference whether the chemical was applied in 30 or 100 gallons of water. The action of ATA on the seedlings was rather slow, three weeks being required before all seedlings were killed. The herbicide, Sinox general, at the rate of 2 gallons in 100 gallons of water to the acre, applied at the same time as ATA killed 75 per cent of the seedlings.

Residual toxicity tests were made with all plots of ATA by bringing in soil samples and gro ing such plants as radish, bean, oats, and corn in them. The toxicity of ATA lasted somewhat longer where applications were followed by dry periods than where rains kept the soil moist. In neither case was toxicity found to occur longer than three months after application.

Since broadleaf plants appeared in the various plots shortly after application of the ATA it seemed possible that this chemical might be used for the control of grasses in certain broad-leaf crops. Greenhouse tests were made where ATA was applied as a preemergence treatment for cotton. Seed of two species of barnyard grass (Echinochloa) were present in the soil. While preliminary, the tests indicated that at rates of 30 to 40 lbs. to the acre, this material prevented the germination of the grass seed. The young cotton plants were injured somewhat but were not killed.

PRESENT FERTILIZER PRACTICES IN LOUISIANA

by Emile A. Maier

Presented at the Meeting of the Agricultural Section, Houma, Louisiana, June 22, 1949.

Fertilizer has been used in the Louisiana sugar cane fields as a general field practice since the memorable fertilizer experiments carried on by Dr. Wm. C. Stubbs, when the Sugar Experiment Station was located at the present site of Audubon Park in New Orleans. A few of our soils respond profitably to the use of other food elements in connection with nitrogen, but, the larger acreage, by far, is fertilized with nitrogen alone - so, this discussion will be entirely on the use of nitrogen as a fertilizer.

In 1947 standing orders to meet fertilizer requirements were cancelled by sales agents at almost the last minute, and some planters in Louisiana were faced with the problem of using any nitrogen available, or doing without. Fortunately, some years before, an experiment carried out at Elm Hall Plantation showed that aqueous ammonia could be used as a satisfactory fertilizer for the cane crop.

Louisiana planters have always considered several factors in choosing a fertilizer. Of first importance is the securing of a nitrogen fertilizer which will produce the best results in sugar per acre. Many trials have been made with different materials from time to time, and for all practical purposes it has been found that regardless of the source of the nitrogen, the sugar cane responds equally well. The second, and a very important consideration, is that of cost. The choice of nitrogen fertilizer through the years, and especially at the present time, is that form of nitrogen which is the cheapest, not only in initial cost, but when applied to an acre of cane. Possibly the cheapest form of nitrogen today is anhydrous ammonia. It may be readily bubbled through water to produce an aqueous form of ammonia, which may be stored in any suitable container that ammonia fumes will not attack.

The use of nitrogen in either ammonia form entails some expense for equipment to handle and distribute it.

AQUEOUS AMMONIA

The University of Tennessee, Circular No. 87, "The Tennessee Liquid Fertilizer Distributor" by M. A. Sharp, describes a Squeege Pump. The pump recommended by this circular was first used in 1947 by Godchaux interests and is still being used to some extent today. It is a positive displacement pump having a set of four operating against a flexible rubber hose, or hoses. The hoses are pulled under tension in a semi-circle around the rollers. As the rollers revolve, a certain amount of liquid is squeezed through the rubber hoses. This pump is attached to the power takeoff of a tractor and may, or may not, be controlledby a clutch. An ordinary globe valve controls the flow of ammonia through the hoses from the tractor's storage tanks which are usually two 55 gallon drums. The amount of ammonia applied is regulated by the inside diameter size of the rubber hose (or hoses) used, as well as by the size sprockets used to couple the pump to the tractor power takeoff.

This pump is a positive metering pump as the rubber tubes retain their original shape. They stretch: due to heat, wear from the rollers and the action of the ammonia solution, hence it becomes necessary to watch the output of a machine rather closely, and to make such necessary adjustments to the rubber hoses that the proper rate of application is maintained.

The Yale & Towne ammonia pump No. 20-D tri-color pump is now being used. Unfortunately, it does not maintain a steady rate of flow for a given setting, and some adjustment throughout the day is necessary. This year, a pump developed by Mr. Russell Ramp of the U.S.D.A. is under trial. It is an all steel, neoprene paddle type, positive displacement pump. To govern the rate of application it is necessary to use different size driving sprockets. This, of course, is objectionable only where it is necessary to apply different amounts of fertilizer in several fields during the day. The pump meters a definite, constant amount.

Rubber hose and pipe carry the ammonia liquor to the distributing shanks which are usually hung on the front of

end of the chopper, so that the chopper will cover the fertilizer immediately. As a rule both sides of a single row are fertilized as the tractor goes down the row. Two row applications have been tried but some difficulty was encountered in getting proper distribution to the rows. An article on the use of Aqueous Ammonia fertilizer for sugarcane, giving full details, appeared in the December 1947 issue of SUGAR magazine.

Aqueous ammonia containing 31.1% ammonia (%NH_3 by weight) may be purchased direct from the manufacturer. The tank car capacity is about 28 tons. This material must be kept under 6 to 10 pounds pressure to prevent evaporation, hence storage tanks must be available. Up to 20 pounds air pressure is used to unload the tank car into the storage tank, field tank, or directly into the drums on the tractor.

To insure an adequate supply of fertilizer for the 1949 crop, the South Coast Corporation erected an ammonia mixing plant at their Oaklawn factory. A complete description of this installation with photographs appeared in the May 1949 issue of THE SUGAR JOURNAL.

Briefly, the installation consists of the following:

6,000 gallon mixing tank
Cooling coil made of 480 lineal feet of 2 inch pipe
100 GPM centrifugal pump for ammonia liquor
Small pump for keeping water on cooling coil
Small tank to trap vapors from mixing tank
Adequate storage space

The mixing tank is partially filled with water and ammonia gas is bubbled through a circular pipe with 1/8 inch perforations at the bottom of the mixing tank. More water is added and the liquor is then kept circulating through the cooling coil back into the mixing tank until the proper concentration of ammonia liquor is obtained. Regular brix spindles are used to check the solution and when a concentration of 23% ammonia is reached the entire batch is pumped into the storage space. In this case steel hulled barges were used to hold the ammonia solution. The 23% ammonia solution will not build up pressure up to 100 degrees Farenheit. The small tank filled with water is used to trap the vapors which may come from the mixing tank, and this small tank is emptied periodically into the large mixing tank as the process is carried on.

One man operated the installation with ease. It takes about four hours to mix and pump into storage a 6,000 gallon batch of aqueous ammonia, 23% nitrogen.

ANHYDROUS AMMONIA

Anhydrous ammonia, as a source of nitrogen for sugar cane was tried out in a limited way in 1947, on field scale in 1948, and throughout the cane area to a large extent in the present season. Anhydrous ammonia is a colorless alkaline gas at normal temperatures and pressures. It possesses a sharp penetrating odor and will irritate the skin and especially the mucous membranes of the human body. More than ordinary plantation care should be used in the handling of this material.

Storage tanks for anhydrous ammonia must meet certain specifications, particularly as to pressure. The recommendation is that the tank should have a working pressure of 250 pounds per sq. in. A Corkens vapor pump is being used with satisfaction to unload anhydrous ammonia from the tank car to storage tanks or to mobile field tanks. It is readily possible to fill the tractor tank from storage by releasing pressure on the small tank through the vapor check. When unloading ammonia gas, gas masks should be worn by the operator, and an adequate supply of water should be kept handy, as ammonia is readily soluble in water, and the water may be used to counteract the effect of any gas which may come in contact with the worker.

Bulk storage tanks are often 30,000 gallon capacity, and should be covered to protect them from the direct rays of the sun. All tanks containing ammonia gas should never be filled to more than 85% of the rated capacity. Field tanks which carry the gas out to the cane fields are often 1,000 water gallon capacity, and are usually carried in trucks, or are equipped with wheels so that they may be readily moved from place to place. Tractor tanks of 110 gallon capacity are generally used.

The operator's control of anhydrous ammonia is secured through a pressure gauge and a valve which can be closely adjusted. Charts have been prepared which permit the operator to set the valve at a certain mark for a given tank pressure and tractor speed. This setting will distribute a definite quantity of ammonia gas per acre covered. At first, it was thought that application of proper amounts would be difficult. However, many users of this material have found that only normal checking of the equipment during the day permitted them to put out the desired amount of fertilizer.

Ammonia is carried from the release valve to the soil shanks which are usually set just in front of a tractor chopper or in front of each side of a two-row middle plow. Little trouble has been found when fertilizing two rows at once. To carry two rows, it is necessary that the valves be equipped with the proper size orifices.

For handling either type of ammonia, it is necessary to use iron fittings and rubber hose pipe which will withstand the action of ammonia and ammonia vapor. Gauges must be carefully constructed, as very small brass screws in pressure gauges have been attacked by the ammonia, and two gauges rendered useless. Some propane rubber hose pipe was used. This soon caused trouble, as the inner lining of the hose softened up and came loose from the body of the hose.

Care should be taken to keep filling pipe and couplings as clean as possible. Some difficulty has been experienced from dirt collecting on the diaphragm of the distributing unit and in the check valves.

GENERAL CONCLUSIONS

It cannot be stressed too strongly that the application of either form of ammonia to the soil should be performed when the soil is in a good state of tilth, to minimize loss from evaporaion Both should be covered to a depth of 6 to 7 inches. Many operators feel that this requirement will make for better farming practices as the field will be cultivated well and be in good condition when the fertilizer is applied.

Many users of both types are confident that the application of the gas or liquid form of nitrogen is less expensive than is the application of dry types of fretilizer. The tanks, gauges, pipes, etc. necessary for the applications do not interfere with the use of the tractors for other work between times when fertilizer is being applied.

Some difficulty has been encountered with the ground shanks bending and breaking off, especially in heavy soils. Such problems are met by strengthening the shanks, but a better solution is to have the soil in a better state of tilth before an attempt is made to apply the ammonia.

Sufficient data is not available to permit quoting figures of yields of sugar cane where either or both forms of ammonia have been applied in comparison with several kinds of nitrogen

fertilizer in the dry form. It may be safely said however that the results in sugar per acre from the applications of either form of fertilizer has been satisfactory. At least no great howl has risen from the cane planters. This is indeed fortunate, as the change from the dry forms of nitrogen was made of necessity and in a great hurry, at a time when there was no other recourse.

Two publications containing much useful information on this subject are:

1. "Ammonia as a source of Nitrogen", a bulletin (Preliminary May, 1947) from the Mississippi State College, Agricultural Experiment Station.

2. "Ammonia - Its Uses and Properties", a publication of the Commercial Solvents Corporation.

CANE MILLING

by Jules A. Lorio, Manager, Sugar Mill Division,
Dilbert, Bancroft and Ross Co., Ltd.

Presented at the meeting of the Manufacturing Section, Houma, Louisiana, July 22, 1947.

Many articles have been written on the subject of cane mills; many theories have been advanced, but as far as grinding cane is concerned, we are still experimenting. We will endeavor to cover, some of the outstanding steps that have been developed in recent years, which have materially assisted in the more efficient manner of juice extraction from the cane.

The Feeder Table and the Cane Carrier have undergone no material changes over a period of years, except superceding steel overlapping slats for the old wooden type slats, and this is as satisfactory a method of cane conveyance as can be designed.

The installation of the Rotary Cane Knife was a great step forward in cane milling, and came at a time when the cane was soft and easy to grind. Since that time we have a new variety of cane having a high fiber content, and it would be impossible to grind any cane today at all without the Rotary Cane Knife. These knives were first operated with steam engines--and some are still operated with steam engines--but it has been found economical to supersede these steam engines with steam turbines. The next step was the installation of two knives without any changes in the cane carrier design. Some of these knives were driven independently and some were coupled together and driven by one engine. The most successful method, up to the present time, has been to operate two sets of knives independently, with two separate individual drives; having one knife operate in one carrier, and the other knife operate on another carrier, which has been dropped so that the ingoing cane to the second set of knives will be turned over and present the bottom of the cane carrier feed to this knife. This prepares the cane in a fairly good manner for the crusher. It has been found, however, in recent years that better extraction can be obtained by using one knife and one shredder. This shredder is of the hammer type with reduction gears

operating at approximately 1000 RPM. This breaks up the cells of the cane in such a manner that after passing through the crusher there exists a better condition for masceration. It also lightens the load considerably on the balance of the mill tandem.

One of the most important stages which has, in the opinion of the writer, been given less consideration than any step in the milling of cane, is the man who feeds the cane into the mill. If we just stop to think; the whole process in terms of capacity, is in the hands of this operator, and usually in the hands of an average employee. Many types of equipment have been designed to make this station automatic, but up to the present, it is still a manually operated station. It has been said that in order to increase human efficiency, it is necessary to create an incentive, and I believe that a certain type of bonus should be paid to this operator in whatever terms that may suit the condition. You will then see an extra amount of tanks made per watch, and in terms of dollars this cost will be infinitesimal. By virture of this incentive you will grind possibly 100 to 150 tons of cane more per day; your mills will choke less, and you will have a more uniform feed through your mill, because it will not take the operator very long to realize that a uniform feed prevents choke that costs him money. He will automatically endeavor to increase the capacity of the mill feed; and the uniformity of this feed will tend to smoother and more efficient operation of the whole plant. The efficiency of the milling plant, and its output depends entirely on the amount of cane ground per day. I personally believe that too much emphasis cannot be placed on this most important station.

It has been the practice in Louisiana to use the two roller type crusher with nine or twelve roller mill tandem. The old Krajewski type crusher is gradually passing out of the picture; still some of the Operating Engineers think they are worth keeping in operation--and maybe they are right. Krajewski type crusher will take any amount of cane you will feed to it, but it will also retain a large percentage of juice, which it has extracted due to its characteristic design. We now supersede the old Krajewski type crusher with a type having annular grooves 3" or 2-1/2" pitch, 50^{o} with Longitudinal grooves cut to within 1/4" to 3/8" of the bottom of the annular groove, and an extra set of longitudinal grooves about 5/8" to 3/4" deep and about 1-1/4" long. It has been found that this extra groove increased the efficiency of the crusher by eliminating

chokes, and the annular grooved crusher gives you a well designed drainage. However, modern milling is now designed with knife and shredder eliminating a two roller crusher and substituting this design with a three roller mill of heavy construction with longitudinal grooves and 2" pitch annular grooves, 50° which has proven to be very successful. The most successful type of shredder installation has been the one in which the shredder has been installed sufficiently ahead of the first station, whether it be a crusher or three roller mill so that the conveyor is of the overlapping or drag type designed to feed into a hopper ahead of the crusher or first mill. This method has been proved superior to the closed type installation.

The two, three, four and possibly fifth mill arrangement which constitutes a tandem, is more or less of the conventional type with very little changes from the point of installation. There are several types of intermediate carriers such as the Ewart Carrier and the Meinecke Carrier, but the most successful type has been the overlapping steel slat type.

The design of the mill itself has undergone radical changes in the last several years. The old kingbolt type has been superseded by the kingboltless type, which permits the roller to operate at a closer combined angle, and gives you a narrower return plate. All cast iron has been superseded by cast steel except the rolls, scraper tips and return plate. The turn beam has been redesigned to have an outside adjustment actuated by an eccentric shaft with bronze crossheafs which permits a quick and easy change of your mill setting during the grinding campaign. The journals of the mill have been increased in diameter and length and all the bearings are made of solid bronze water cooled design. The hydraulic pressure has increased on new mill design, so as to carry from 400 to 600 tons pressure per mill.

The old type weight Hydraulic Accumulator has been superseded by the Munson type air accumulator, which facilitates the change of pressure on your mill by a regulating valve, which pressure can be changed at will during the operation of the mill. The speeds of the mill have been increased from 25 feet per minute to 40, 50, and in some instances 60 feet perminute so that the capacity of mills correspondingly increased. There is a question as to the advisability of mills operating up to 60 feet per minute and at the same time retaining the proper mill efficiency that would be possible at a slightly lower peripheral speed.

The gear design has undergone changes also with the corresponding theories pro and con. The first reduction

has now been replaced by cut gears of approximately 1-D P, either straight cut or herringbone type increasing the face to develop the necessary horse power. All pillow blocks are now made of cast steel, babbitted or bronze lined. The intermediate and main spur shafts have been increased in size and all of uniform diameter, with one type of pillow block bearing for all shafts. The bed plates are now made of cast steel bolted together with key type locking device which makes it impossible under any operating condition to break this installation.

At this point I would like to give you an example of what happened in 1941. In that year we made for Godchaux Sugars, Inc. a complete gear bedplate to drive a nine roller mill with its corresponding cast steel pillow blocks using the old gears. In this gear train all old gears were made of cast steel except the last main spur gear. This gear train is driven by a 28" x 60" Corliss engine. Under full load with its engine running 50 RPM a section of the last cast iron gear rim broke and fell into the main spur gear pinion which instantly stopped the whole gear train. With the fly wheel endeavoring to continue its momentum, the only break which occurred was bending an 11" intermediate gear shaft having 40" centers. A spare cast steel was on hand which was placed on the main spur gear shaft. A new intermediate gear shaft was made and operation was resumed after a twelve-hour shutdown, which thoroughly demonstrates the rigidity of this type of gear construction.

It is the opinion of the writer, that a nine roller mill should not be operated with one engine. However, we manufacture and design nine roller mills driven by one engine due to the cost involved, and the wishes of the purchaser.

No mill will operate uniformily. Each mill has characteristics of its own and with an independent engine driving the last mill, flexibility can be obtained which is not possible with a one engine drive.

The ideal milling condition is to have each mill separately driven. This has been done successfully in foreign countries with separate electric motor drives, which are an exception rather than a general rule. As factories are still adhering to the steam driven power, it is with pride that I can state that Louisiana, at this time, is experimenting with an individual mill drive, which I think will be the answer to the future mill power requirements.

Due to the foresightedness of one of the young managing

sugar engineers, Mr. Charles S. Savoie, who will put out his money on an idea, I feel that the Sugar Industry will greatly benefit. At Lula Factory, they will install for the grinding campaign of 1947 a single steam driven turbine on the last mill at a cost of about $20,000. All the necessary data has been carefully assembled and computed and participants in the design of this equipment feel that it will be a success. At a cost of $20,000 to $25,000 for a complete mill drive of this type there is a considerable savings over the conventional type of engine, gear train, and foundation cost; and the flexibility accomplished in this type of design far exceeds the initial cost.

In conclusion I wish to say that the Louisiana Factories; notwithstanding the lean years and the good years, have kept abreast of the times, and most of our factories today compare favorably with factories of other parts of the world. The factory owners have placed their problems in capable hands, and with proper legislation, Louisiana will continue to be a sugar producing State, which has been such a material help to the whole sugar situation of the United States in our recent crisis. This industry urgently needs proper legislation so that Louisiana will continue to be a sugar producing State which past experience has shown to be of vital interest in times such as exist today.

THE USE OF WRIKORG C FOR SCALE PREVENTION IN SUGAR EVAPORATORS

by Frank W. Mrazek, Chemical Engineer, and Floyd H. Wright, President Wright Chemical Corporation, 627 West Lake Street, Chicago, Illinois

Presented at the Meeting of the Manufacturing Section, July 22, 1947

Probably nothing interfers with the efficiency of evaporators in a sugar mill or refinery to a greater extent than fouling of heat transfer surfaces by the formation of scale. Until recently, scale deposition was considered an unavoidable limiting factor to the length of run between cleanouts, the period between which varies from as little as two or three days to about two weeks, depending upon the composition of evaporator influent and other local conditions. The cleaning-out process is expensive, due not only to loss of efficiency, but to cost of down time, labor, boiling out chemicals, and corrosion caused by the latter. When the evaporator is again put in service, it is not long before loss of efficiency is noticeable; and becomes progressively greater and greater, until it is so low that another shut-down is necessary. This cycle is a source of continuous trouble and loss of profit to the producer.

Scale deposition in a sugar mill evaporator differs from that in a refinery evaporator. In the former, deposition is least severe in the first body and increases progressively in succeeding bodies, while in the latter the reverse is the case. The composition of scale deposited in the sugar mill evaporator is much different from that in the refinery, due to difference in mineral constituents carried into it by the influent. These differences are illustrated by the following analyses of cane juice and scale from a sugar mill evaporator and of sweet water and scale from a refinery evaporator. Complete water analyses were run on the cane juice, but only the mineral constituents significant in the formation of scale are given below. Results are the average of several analyses made in the laboratories of the Wright Chemical Corporation.

AVERAGE COMPOSITION OF SYRUP ENTERING EVAPORATOR

Ions	Parts per Million
Calcium (Ca)	175
Magnesium (Mg)	65
Iron (Fe)	11
Silica (SiO_2)	225
Phosphate (PO_4)	235
Sulphate (SO_4)	680

In their Cane Sugar Handbook, Page 172, Messrs. Spencer and Meade quote an analysis of samples of scale from each pan of a quadruple effect evaporator concentrating cane juice as reported by Prinsen-Geerligs (1) which shows the variation in composition very well. Essential parts of these analyses follow:

SCALE FROM CANE JUICE EVAPORATOR

	1st Pan %	2nd Pan %	3rd Pan %	4th Pan %
Calcium phosphate	57.85	56.98	15.02	7.49
Silica	7.79	7.43	39.26	54.34
Combustible Matter	20.37	13.41	11.04	5.08

In the first two effects, scale is high in calcium phosphate and comparatively low in silica, while in the third effect the latter comprises more than one-third, and in the last effect more than one-half of the total; combustible material in the scale decreases progressively through the system. Particular attention is called to the last fact, as it has a direct bearing on the amount of scale deposited in the various bodies and on formulation of a treatment to prevent its deposition.

The following fragmentary analysis of a spot sample of sweet water collected just ahead of the evaporator in a refinery is fairly representative, although the composition may vary to a considerable extent, even in the same refinery.

COMPOSITION OF SPOT SAMPLE OF SWEET WATER

Ions	Parts per Million
Calcium (Ca)	830
Magnesium (Mg)	100
Iron (Fe)	11
Silica(siO_2)	810
Sulphate (SO_4)	900
Phosphate (PO_4)	7

Sweet water, as a rule, is more highly mineralized than cane juice, particularly in calcium, silica and sulphate content, and phosphate is usually very much lower. An analysis of scale from a sweet water evaporator is shown below. This was deposited during a different run from that made with the above evaporator influent, and, unfortunately, is from a Lillis evaporator, but is characteristic of the average composition of such deposits.

SCALE FROM SWEET WATER EVAPORATOR

Salts	Percent
Calcium Sulphate	77
Calcium Phosphate	trace
Magnesium Carbonate	4
Silica	8
Iron Oxide (Fe_2O_3)	2
Combustible Matter	9

Even a cursory examination reveals the difference in composition between this scale and that deposited in a sugar mill evaporator. The latter is made up largely of calcium phosphate and silica, while the scale from the sweet water evaporator is composed mostly of calcium sulphate. In the refinery evaporator, heaviest scale deposition occurs in the first body, in contrast to being heaviest in the last body of the mill evaporator.

Approximately five years ago, one of the authors was given the opportunity to introduce a treatment for control of scale in aqueous systems into an evaporator at the American Sugar Refinery in Louisiana, through the cooperation, pioneering spirit of Mr. M. D. Scott, General Manager.

Scale in the evaporator had caused considerable trouble prior to the time a trial run was made. It was very hard and thick, some would break off during operation and pile up against the tube sheets to a depth of twelve inches, and some would lodge between tubes and stop sweet water circulation. Cleaning the evaporator had always been a veritable nightmare, and every available method of boiling out, mechanical cleaning, and combinations of the two had been tried. Evaporator runs were short and troublesome, and it all added up to such a discouraging situation that no one connected with the test entertained hope for much relief. It was hoped, however, that treatment would so change the composition or physical characteristics of the scale that removal would be made easier and less costly. The water treatment used was a greenish to yellowish brown viscous material with a specific gravity of 1.384 and pH of 5.9; 80 to 90 percent of it soluble in hot water, the insoluble portion being inert organic matter. Solutions of this material had to settle for from twelve to twenty-four hours and then be drawn off from a level above the sediment for use. (2) Sediment was then run to waste. This is a polyphosphate treatment, the effect of polyphosphate being to delay precipitation of insoluble calcium and magnesium salts.

In the case in point, addition was begun at the rate of one pound of treatment per ten thousand gallons of sweet water, of 5^{o} to 10^{o} Brix concentration, the intention being to control dosage accurately by a rapid colorimetric test for phosphate content of the sweet water. It was found, however, that there was too much interference by organic constituents in the sweet water, and that for this application the test was unreliable. After trying to control by this test for some time, without success, it was decided to use the appearance of the evaporator when it was opened each week for inspection as a criterion for regulating dosage. The effect on scale deposition was satisfactory, but the remedy was not complete, since it still was necessary to resort to mechanical cleaning weekly or by-weekly. Boiling out, however, was required only once during a year's operation. This occurred after a lot of "muddy" press water had been allowed to enter the evaporators, due to inefficient labor elsewhere in the plant. More than the cost of treatment was saved by practically eliminating the requirement for boiling out chemicals and by reduction in the cost of labor necessary for cleaning. This refinery,

however is equipped with Lillie evaporators which can tolerate more scale than quadruple effect evaporators. Therefore, while it is logical to assume that cost would have been somewhat greater with the latter equipment, they still would have been much lower than for boiling-out regularly.

It was thought that this method of scale prevention would be fully as applicable to sugar mill evaporators as to those in a refinery, but it was about two years before the author had an opportunity to introduce it into a sugar mill in Louisiana. By observation of satisfactory results obtained with this treatment in evaporators at an alcohol plant, Mr. Thomas G. Holmes, Chief Chemist and Superintendent of Fabrication at the Evangeline Pepper and Food Products Company sugar mill, was led to believe that the same treatment would be of value in sugar mill evaporators. Accordingly, he began its use in 1945, adding 1-1/2 pounds per hundred tons of cane. The ordinary colorimetric test for phosphate was even more useless in the sugar mill than in the refinery, so control was by observation of the effect in the evaporator. The evaporators were clean at the start and ran for forty days before a boiling-out was necessary. After thorough cleaning, they were run until the end of the season, a period of thirty days more, without the necessity of boiling-out. Inspection of evaporators before final cleaning showed that the first two bodies were essentially free of scale, but the third body contained a moderately heavy deposit and the fourth a heavy deposit.

At the beginning of the 1946 grinding season, it was decided to use three pounds of treatment per one hundred tons of cane, with the expectation that it would practically eliminate scale deposition in all four bodies. Instead of that, the evaporators were so badly scaled at the end of ten days' run that it was necessary to shut down and boil out. Treatment dosage was reduced to that of the previous year--1-1/2 pounds per one hundred tons of cane--which improved conditions, but results for the season were not nearly as good as during the previous year. Out of five mills that used the material, two failed to improve conditions, while the experience of the others was similar to that of the one just discussed. In all cases, if dirty cane was being crushed, treatment to prevent scale deposition; and whenever it became necessary to shut down evaporators for cleaning, the heaviest deposit was found in the last effect, regardless of the condition of cane at the time.

The fact that scale in sugar mill evaporators, concentrating cane juice naturally high in phosphate, is heaviest in the last effect, while in refinery evaporators, concentrating sweet

water normally very low in phosphate, is heaviest in the first effect, at first led us to believe that phosphate was responsible for preventing its deposition. Experience at the Evangeline mill, however, seemed contradictory to this conclusion since, when the dose of treatment was doubled, it caused heavy deposition rather than complete elimination of scale. In order to determine if there was an optimum concentration of phosphate for successful treatment of cane juice, samples of the clarified liquid were taken and 0-2-4-10-20 and 30 parts per million of treatment added. All samples were then heated for thirty minutes in a boiling water bath and the effect observed. The untreated sample became very turbid, that treated with 2 parts per million remained clear, that obtaining 4 parts per million became slightly turbid, that containing 10 ppm. turbid with some evidence of precipitation, that containing 20 very turbid with definite precipitation, and that containing 30 extremely turbid with formation of a heavy precipitate. These results are tabulated below for easier comparison.

Treatment Content	Turbidity	Precipitation
0 ppm.	Very turbid	None
2 ppm.	No turbidity	None
4 ppm.	Slightly turbid	None
10 ppm.	Turbid	Slight evidence
20 ppm.	Very turbid	Definite evidence
30 ppm.	Extremely turbid	Heavy

Appearance of turbidity in the solution was taken as an indication of its ability to deposit scale, and the degree of turbidity along the formation of a precipitate as a criterion of the amount and rapidity of deposition. Some of the precipitate was filtered off, washed, and then tested for calcium and phosphate. Strong positive qualitative reactions were obtained for both, showing that the insoluble matter was largely calcium phosphate. It is admitted that the test was rather crude, but it did give some idea of the effect of increased dosage and served, in conjunction with operating results, as a basis for concluding that there is a limit to the amount of phosphate which can be added without causing trouble, and that the limit is very low, being between two and four parts per million of treatment, only part of which, of course, is phosphate. Results also seemed to indicate that polyphosphate needed the aid of a very strong colloid, if it was to keep evaporators entirely free of scale, and that the colloid present in this

treatment was not able to give it the necessary help. Upon arriving at these conclusions, a search was made for a polyphosphate treatment containing a colloid that would meet these conditions and one was located, called Tetrafosforg, a product of the Wright Chemical Corporation. Preliminary tests on this product indicated that its use would result in complete elimination of evaporator scale, and it was decided to introduce it into some sugar mills and refineries that had been using the other treatment.

TETRAFOSFORG

Physical Properties:

Color	-Slightly yellow by transmitted light.
Clarity	-Somewhat turbid. Turbidity very finely divided and settles with extreme slowness. The slight sediment that may form is so finely divided that it cannot give trouble in any type of proportioning equipment.
Consistency	-Somewhat viscous; about the consistency of a thin syrup.
Specific Gravity at 70°F.	-1.35
Weight per Gallon	-11.26 pounds.
Solubility	-Soluble in all proportions in water at ordinary temperature. Only a trace of insoluble matter.

Chemical Properties:

pH	-7.00
General	-Tetrafosforg is a neutral phosphate product, containing a mixture of highly surface-active organic colloids.

Chemical Properties
(continued)

Indicated uses -Used for prevention of scale deposition in both hot and cold water systems.

Toxicity -Non-toxic in the concentrations used for scale prevention. Can be used in cases where it may enter products destined for human consumption.

Tetrafosforg was first used in a refinery for treatment of a sweet water evaporator, being added at the rate of one pound per ten thousand gallon just ahead of the evaporator. At the end of the first week's run the evaporator was opened for inspection and found to have a slight scale deposit, but so little that no cleaning was required. This was a disappointment to the writers, as it was expected that no scale would be found, but the operators were well satisfied, because with previous treatment mechanical cleaning had been required at the end of each week's run. At the end of the second week it was found that enough scale had been deposited to require mechanical cleaning, and there was also a considerable deposit of sludge in the bottom of the evaporator. This represented better operation than at any previous time, but also showed that complete elimination of scale had not yet been attained. Samples of both scale and sludge were collected and submitted to the laboratories of the Wright Chemical Corporation for analysis. Results obtained are as follows:

SCALE AND SLUDGE FROM SWEET WATER EVAPORATOR

Salts	Scale	Sludge
Calcium Sulphate	63%	35%
Calcium Phosphate	13	8
Magnesium Phosphate	3	2
Silica	5	34
Iron Oxide (Fe_2O_3)	3	3
Combustible Matter	13	18

Unfortunately, no samples of the sweet water being concentrated were collected and analyzed. Scale analysis, therefore, must be referred to the analysis of scale from untreated sweet water given previously. The two are tabulated below:

SCALE FROM SWEET WATER EVAPORATORS

Salts	Untreated %	Treated %
Calcium Sulphate	77	63
Calcium Phosphate	Trace	13
Magnesium Carbonate	4	None
Magnesium Phosphate	None	3
Silica	8	5
Iron Oxide (Fe_2O_3)	2	3
Combustible Matter	9	13

Comparison of these analyses shows that calcium sulphate runs lower in the untreated sweet water, calcium phosphate much higher, magnesium is present in treated sweet water scale as the phosphate while it exists as carbonate in the scale from untreated sweet water, silica and oxides of iron run about the same in both scales, and combustible matter is considerably higher in the scale from treated sweet water. This indicates that the phosphate added must be contributing materially to scale formation, because sweet water ordinarily runs very low in phosphate, and scale deposited from it without treatment also contains only a very small proportion.

The difference in composition of scale and sludge is also very interesting. The latter contains only approximately one-half the amount of calcium sulphate and almost seven times the amount of silica as the former, and the content of combustible matter is higher. This led to the conclusion that so much colloid was consumed in preventing silica from depositing as scale that not enough was left to prevent deposition of calcium sulphate and phosphate. This initiated some experimental work in the laboratory that ultimately materially changed the conception of what happens in the evaporator, and finally led to the formulation of an entirely different treatment.

The There were ten sugar mills which used Tetrafosforg during the 1946 season, all of them getting better scale elimination than at any previous time. Some mills were able to make

long runs without boiling-out, while others could not lengthen their runs to a great extent; but, due to better heat transfer during most of the period between boil-outs, succeeded in materially increasing production. Variations in effectiveness could be traced to differences in cane, extent of milling, and juice treatment prior to evaporation, the effect of the latter, being most marked. In a few cases, some of the cane milled was much dirtier than usual, which causes the evaporators to scale up to such an extent that boiling-out was necessary, but for what may be termed normal operating conditions all mills using Tetrafosforg had less evaporator trouble than with any previous treatment.

Regardless of improvement in conditions, the Wright Chemical Corporation still was not satisfied, since its object was to maintain evaporators scale-free under all conditions. Intensive work on the problem was continued in its laboratories, and results obtained gradually led to a revision of the idea of the value of polyphosphates in evaporators. We finally concluded that, unless applied under far more careful control than is economical or even possible in mill or refinery practice, the polyphosphates would increase scale formation rather than prevent it.

Polyphosphates, while they remain as such form soluble compounds with scale-forming elements which apparently have the property of keeping far more than an equivalent amount of scale-former from precipitating. However, they also have the property of reverting to orthophosphate in solution, reversion being slow at ordinary temperatures, but much accelerated by rise in temperature and by the presence of acid, or by a combination of the two. Orthophosphates do not have the property of forming soluble salts with scale-forming elements, nor of delaying precipitation of their salts, but form insoluble calcium and magnesium orthophosphates which are prone to adhere to hot surfaces and form scale.

If we again refer to the analysis of scale that formed in the refinery evaporator treated with Tetrafosforg and compare its composition with that from the untreated evaporator, this action of polyphosphate becomes evident. Scale from the untreated evaporator, contained only a trace of calcium phosphate and no magnesium phosphate, while that from the treated evaporator contained 13% of calcium phosphate and 3% of magnesium phosphate, both salts or orthophosphoric acid formed by the reversion of polyphosphate.

Now, if we refer to the analysis of scale from the four effects of the sugar mill evaporator, we see that the samples

from the first two effects are more than one-half calcium phosphate, the source of this phosphate being the cane juice which normally has a high content. It was present in the juice as orthophosphate, which combined with the calcium present and was deposited on the hot surface as scale. Experiments in the laboratory confirmed this theory, and even the simple test already described was confirmatory, since increasing the amount of treatment caused an increase in the amount of calcium phosphate that separated.

Since work had shown that the addition of polyphosphate treatment above a very low concentration only increased scale deposition, the only conclusion to be drawn from plant results and experimental work in which it did not separate was that the colloid was responsible. We have pointed out before that in the sugar mill evaporator the smallest amount of scale forms in the first body and increases to a heavy deposit in the last, while in the refinery evaporator the opposite occurs, heaviest despoition being in the first body. If we now refer once more to the analysis of scale from the four effects of the sugar mill evaporator, it will be noted that the sample from the first pan contains 20.37% of combustibel or organic matter, the second contains 13.41%, the third 11.04%, and the last 5.08%. This is in reverse order to the amount of scale deposited. Raw cane juice contains much colloidal matter that interferes with separation and greatly lowers the quality of the sugar. The removal of the colloid is the purpose of the defecation process. Part of the colloid is too stable to be removed completely by defecation, however, and passes on into the evaporator. It is the presence of this colloid that prevents heavy deposition of scale in the first pan of the evaporator, and as it is used up--shown by the decreasing amount appearing in the scale--progressively heavier deposits form. Sweet water in the sugar mill normally contains very little organic colloidal matter, and for that reason the greater part of the scale separates in the first and second bodies if a multiple effect evaporator is used for its concentration.

In order to test this theory, regarding action of phosphate, several samples of Tetrafosforg were made up with progressively lower content of phosphate and higher content of mixed colloids, and their effect noted on precipitation of calcium phosphate from cane juice. The same amount of each treatment in parts per million was used in each test, and each was heated for one-half hour in a boiling water bath. It was found that separation of calcium phosphate

decreased in direct proportion to decrease in phosphate content of the treatment. A solution of mixed colloids alone gave the best result, no separation whatever occurring except on long heating in the water bath, and then the amount was scanty. Results of this laboratory work led to the conclusion that use of colloidal treatment free of phosphate would prevent scale deposition entirely. Accordingly, a treatment was made up on this basis, given the trade name Wrikorg C, and arrangements for running a test with it at a sugar mill in Louisiana.

WRIKORG C

Physical Properties:

Color	-Colorless, sometimes with a very slight yellow tinge.
Clarity	-Clear in thin layers. Thick layers are translucent like strong solutions of most organic colloids.
Consistency	-Viscous; approximately the consistency of a moderately thick syrup.
Specific Gravity at 70°F.	-1.01
Weight per Gallon	-8.42 pounds.
Solubility	-Soluble in all proportions in water at ordinary temperatures. No insoluble matter.

Chemical Properties:

pH	-8.30
General	-Wrikorg C is a midly alkaline solution of a highly surface-active organic colloid mixture.
Indicated Uses	-For prevention of scale deposition by hot or cold aqueous solutions.

Chemical Properties:
(continued)

Toxicity -Non-toxic. Approved for use in food products.

In practice, Wrikorg C may be diluted with cold or hot water to any concentration desired, and then fed into the stream of whatever solution is being treated in proportion to the flow by means of any type of proportioning equipment available. No trouble due to stoppage in orifices or small tubes is encountered.

As stated previously, a test run was made with Wrikorg C in a clean evaporator at a sugar mill in Louisiana, introduction being made at the rate of 1-1/2 pounds per 100 tons of cane. One-half pound per 100 tons cane was added to the first effect, and one pound directly into the third effect. Inspection of the evaporator after shutdown revealed that no scale whatever was deposited anywhere in the first and third effects, while the second and fourth bodies contained only a paper-thin deposit near the bottom of the tube. This indicated that fresh treatment should be introduced into each body of the evaporator and that perhaps a slight increase in the total amount applied was necessary. As this mill was closing until next grinding season, the indicated changes could not be made. Grinding was still in progress in Mexico, however, and two chemists of a large sugar company in that country, who witnessed the test in Louisiana, were anxious to use Wrikorg C in one of their mills. They purchased a supply and were instructed to use two pounds per 100 tons of cane, added as follows: 1/4 pound to the first body of the evaporator, 1/2 pound each directly to the second and third bodies, and 3/4 pound to the fourth body. Since the various bodies operate either at or below atmospheric pressure, introduction of treatment solution is a comparatively simple process.

SUMMARY

1. The mechanism of scale formation in sugar mill and refinery evaporators has been discussed and a theory regarding its formation and distribution in the various effects in each case formulated.

2. It has been shown that treatment of cane juice or sweet water with colloid-polyphosphate mixtures prevents deposition of scale in evaporators to a considerable extent.

3. Interpretation of analyses, practical experience, and laboratory research have shown that treatment of cane juice and sweet water with phosphate mixtures ultimately results in an actual increase in the amount of scale deposited.

4. It has been demonstrated that naturally occurring colloids in cane juice result in delaying scale formation until the last two effects of the evaporator, and their absence in sweet water causes heaviest deposition in the first two effects.

5. Observations and conclusions just summarized have resulted in formulation of a colloid treatment that gives great promise of completely eliminating both mechanical cleaning and boiling-out of sugar mill and refinery evaporators and is applicable to many analogeous processes.

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ADVANTAGES OF HIGH SPEED CENTRIFUGALS IN THE SUGAR INDUSTRY AND FACTORS AFFECTING THEIR EFFICIENCY

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Presented at the American Society of Sugar Cane Technologists, October 2, 1948

For clarification as to what is high and what is low speed, we are, in this paper, defining high speed as those speeds above 1200 RPM on a 40" x 24" x 6" centrifugal basket. The conventional or low speeds are therefore, any speeds at 1200 RPM or less.

There are many 40" x 24" x 6" centrifugals operating at 1400, 1500, and 1600 RPM and processing the higher purity massecuites, while on low grade massecuites the usual high speed recommended and in use is 1800 RPM.

A comparison of the centrifugal force or gravities developed by the various speeds follows:

	Centrifugal RPM	Centrifugal Force (Gravities) 40" Basket
Low Speed	1000	568
Low Speed	1100	688
Low Speed	1200	819
High Speed	1400	1114
High Speed	1500	1278
High Speed	1600	1455
High Speed	1800	1842

The most common high speed on raw sugars (A and B), affination, and fine grain white sugars is 1600 RPM and in the majority of cases, 1800 RPM on low grade massecuites, such as "C" massecuites in a raw house and the lower purity remelts in a refinery.

The question naturally arises as to the objective of the high speed centrifugal and what determines whether high speed or low speed is most applicable for a given job.

There are two chief factors in the massecuite itself that affect the purging rate. These two factors are the sugar grain characteristics and viscosity of the mother syrup. The grain characteristics have more influence over purging rate than viscosity. Any improvement in the purging of a massecuite is judged by the degree of separation of crystals and syrup or molasses and the time in which to accomplish it.

For a given massecuite, all other conditions being equal, the purging rate increases as the speed is increased. One objective therefore, of the high speed centrifugal is to obtain the optimum processing achievement in the minimum time, or high capacity per unit.

The consumer demand for fine grain refined sugar had much to do with the introduction of high speed centrifugals into the phase of production. In order to obtain the best possible processing results without increasing the number of centrifugals required for any given production it was necessary to go to higher centrifugal speeds. In fact, the introduction of high speed centrifugals resulted in a material reduction in the number of units required for a given production even when the three boiling system was generally adopted by both the cane and beet sugar industries.

The syrup or molasses content of a massecuite is composed of three phases as follows:

1. The free or excess syrup above that required to fill the voids between the crystals.
2. The syrup between the crystals called the "Void" syrup.
3. The syrup film on the crystals.

The number one phase is readily removed and requires the minimum centrifugal force. The difference in its elimination rate is rather small for various centrifugal speeds.

The number two phase is subject to much faster elimination rate as the centrifugal speed is increased. In the elimination of the Void syrup and the time required to eliminate a given quantity of syrup approaches a direct increase relationship to the centrifugal force employed.

To remove as much as possible of the number three phase, the film syrup, greater centrifugal force is required, and equilibrium is reached when the force tending to remove more film syrup is counterbalanced by the force

(adhesion) with which the syrup film is held to the crystals. To obtain a maximum syrup elimination in a minimum time high centrifugal force is therefore, required.

Also, the Voids between crystals are greater with coarse grain and less syrup is held back as film syrup adhering to the crystal surfaces. To put it another way, there is a lower crystal surface - weight ratio. With coarse grained massecuites, the centrifugal speed requirements for a certain degree of syrup elimination are much less than with fine grained massecuite. With coarse grained massecuites of high purity where viscosity is lower high centrifugal speeds afford no particular advantage over the ordinary speed such as 1150 RPM with a 40" diameter basket.

Most of the refined granulated sugar produced in this country can be classified as fine grain, also viscosity enters the picture more and more as the purity of the massecuites are lowered. This paper will, therefore, deal almost exclusively with high speed centrifugal operations and conditions or factors affecting their efficiency.

In all cases, regardless of centrifugal speed, if high quality sugar is to be produced the syrup film remaining on the crystals must be removed by a washing agent. One advantage of the high speed centrifugal is that the amount of syrup film to remove has been reduced to a minimum and therefore, less washing is required to remove this film with the result better separation of washings from the run-off syrup is obtained along with a higher washed sugar yield.

Grain characteristics affect the degree of syrup elimination more than viscosity. These characteristics are produced in the boiling and crystallizer operations, and they cannot be changed to advantage after the massecuite has left the pan or the crystallizer.

The viscosity of any sugar solution is a direct function of the concentration and an inverse function of the temperature. The viscosity can be reduced either by water dilution or by increase in temperature. Viscosity can be controlled more readily and economically by heat treatment than by dilution.

The main objectives of high speed centrifugals are, therefore, as follows:

1. To obtain maximum capacity per unit through faster elimination of syrup and thus reduce the number of centrifugals required for any given production.
2. To obtain more effective separation between washings and run-off syrups where the quantity of wash water used is sufficient to warrant separation.
3. To obtain more uniform quality of sugar produced.
4. To obtain maximum purity of low grade sugar without necessity of washing where such a product is preferred or to make it possible to wash such sugars and secure worthwhile separation between final molasses and washings.
5. To better control separation of washings and run-off syrups and thus obtain better boiling house control of massecuite purities.
6. To obtain in the case of white sugar production, a sugar of lower moisture content from the centrifugals which simplifies drying operations and in turn produces a sugar of better lustre.
7. To reduce washing of refined sugar to a minimum requirement and thus improve pan yields.

It has been mentioned that the grain characteristics and viscosity are the two chief factors affecting the purging of the massecuites. The factors must be considered to secure best results from centrifugal operations are as follows:

1. Proper speed or selection of centrifugal force applied.
2. Control of massecuite fluidity or viscosity and the maintenance of a uniform fluidity during entire purging operations.
3. Automatic control of the centrifugal cycle components.
4. Control of acceleration rate of centrifugal to provide for each type of massecuite the acceleration that gives maximum elimination of syrup in a minimum time.
5. Proper washing technique.
6. Proper type and design of centrifugal baskets and screens.
7. Proper type of syrup separating equipment.

The application of high speed centrifugals to the processing of specific massecuites and magmas will now be taken up separately.

Raw Sugar Production from "A" and "B" Massecuites

By raw sugar we refer to 96 degrees or higher polarization. While raw sugar massecuites (A and B) as a rule contain fairly coarse grain there is usually a mixture of grain sizes that tends to retard purging and also fairly high viscosities are present.

The chief advantage of high speed centrifugals in raw sugar production is high capacity per unit and production of a raw sugar having a better "factor of safety" which is most desirable where storage extends over any period of time either in warehouses or in shipments.

Typical results are as follows:

	MASSECUITES	
	A	B
Maximum centrifugal RPM	1600	1600
Acceleration rate, seconds	70	70
Massecuite, RDS	92.6	93.4
Massecuite Purity	82.4	73.8
Molasses Purity	60.1	51.9
Temperature (°C-°F) of massecuite to supply crystallizer	71-160	68-156
Temperature (°C-°F) of massecuite from supply crystallizer	63-143	68-156
Temperature (°C-°F) of massecuite as purged	70-158	50-140
Wash water used	none	none
Raw sugar polarizations	97.6	97.4
Raw sugar % moisture	0.54	0.61
Factor of Safety	0.20	0.24
Average cycle, load to load	2'-30"	2'-45"

AVERAGE SCREEN ANALYSIS

Retained on 14 mesh	0.9	1.0
Retained on 20 mesh	13.9	7.0
Retained on 28 mesh	39.0	28.8
Retained on 35 mesh	35.3	35.3

AVERAGE SCREEN ANALYSIS
(Continued)

Retained on 48 mesh	9.3	18.0
Retained on 65 mesh	1.4	4.3
Retained on 100 mesh	0.4	1.0
Through 100 mesh	0.2	1.7

The polarizations here shown are higher than is desired is some producing areas. However, by not washing the "B" sugar and blending it in ratio of production with the "A" sugar, a polarization of 96-97 is obtained.

Washed "A" and "B" Sugars of High Purity

By the combination of high speed centrifugals, viscosity control of the massecuite and proper washing technique it is comparatively easy to produce high purity washed sugars in one centrifugal operation. This is of advantage where raw sugar factories refine their own raw production or where a direct sale of this type of sugar is made.

In such cases, a fairly rapid rate of acceleration of the centrifugal is desirable and all cycle components must be automatically controlled for best results. Also, a uniform fluidity should be maintained and interval washing using superheated wash water is definitely an advantage.

The double purging of the "A" and "B" sugars, in the case of a raw sugar plant refining its own raw production is eliminated.

By the use of high speed and interval washing, very effective separation of the washings and molasses is secured and is of direct advantage in control of the "A" and "B" massecuites and quantity of each boiled.

Typical results obtained are as follows:

Raw Sugar Massecuites

	A	B
Centrifugal RPM maximum	1600	1600
Acceleration rate, seconds	60	60
Massecuite, RDS	92.3	92.9
Massecuite Purity	81.6	72.2
Molasses Purity	59.5	51.3
Washings Purity	83.1	74.8

	Raw Sugar Massecuites	
	A	B
Washed Sugar Purity	*99.8	*99.6
Temperature (°C & °F) of massecuite to supply crystallizer	65-149	67-153
Temperature (°C & °F) of massecuite from supply crystallizer	56-133	58-136
Temperature (°C & °F) of massecuite as purged	65-149	66-151
Average total seconds washing (2)	12	12
Average total cycle, load to load	2'-40"	3'-0"
% Moisture in sugar from Centrifugals	0.41	0.48

SCREEN ANALYSIS OF SUGAR

	A	B
Percent on 20 mesh	11.8	9.5
Percent on 30 mesh	35.4	31.6
Percent on 40 mesh	33.1	35.4
Percent on 50 mesh	10.5	12.6
Percent on 60 mesh	6.2	6.5
Percent through 60 mesh	3.0	4.4

*Polarization on oven dried sugars.

In this particular case the hot sugar from the centrifugals, after being elevated and cascaded to supply bin, was bagged for storage and moisture content of bagged sugar ranged from 0.10 to 0.15 percent.

An ordinary granulator without heat application but to serve only as a combined cooler and drier, gives very good results for bulk or bagged storage.

Final Crystallizer Massecuites ("C" Massecuites in raw sugar plants and final remelt in refineries)

The grain characteristics and viscosity are more aggravated in the lower purity massecuites and the boiling operations necessary to produce a massecuite containing uniformity of grain size become more difficult and require more supervision and control.

From the standpoint of high centrifugal capacity, a massecuite containing large and uniform grain is desirable. However, the larger the grain the smaller the crystal surface area or surface - weight ratio and the smaller the surface-weight ratio, the slower is the rate of crystallization.

To obtain maximum crystallization in a minimum time and lowest possible final molasses purity, it is necessary to have a large crystal surface-weight ratio, as well as a properly controlled rate of cooling and the finer the grain size, the greater the centrifugal force must be to produce the highest possible sugar purity in a minimum time.

The essentials, therefore, to obtain the best possible results from centrifugal operations, are as follows:

1. The massecuites must contain sufficient grain uniformity to allow uniform and exhaustive purging of the massecuite and the complete avoidance of the so-called skin formation on the sugar wall.

   The skin formation sometimes observed on the sugar wall in the centrifugal basket is definite proof of the presence of badly mixed or smear grain in the massecuite. If maximum purity unwashed sugar is to be obtained or sugar washed to high purity and effective separation of the washings and molasses secured, there must be a certain degree of grain uniform and as low viscosity as possible without appreciable dissolution of grain. Graph I illustrates effect of grain size and uniformity on the purging rate.

2. The massecuite should be purged as close to the saturation temperature as possible. Any prolonged heating in the crystallizer tends to dissolve sugar grain and also use up crystallizer capacity. Rapid heating of a small volume of massecuite to the saturation temperature just before purging and having a small temperature differential between temperature of massecuite purged and heating medium is preferable. Graph II illustrates the effect on purging rate as the viscosity of the massecuite is decreased.

3. High speed centrifugals with automatically controlled components and having sufficient capacity to permit maximum exhaustion of molasses.

   This is particularly essential if sugar is to be washed to high purity and worthwhile separation between washings and final molasses secured.

4. The acceleration rate of the centrifugal should be gradual, preferably between 3 and 4 minutes. This is particularly true if the grain is badly mixed or contains smear. If acceleration in too rapid, a packed sugar layer next to the screen develops, which seals off molasses elimination. A slow accelerating low speed centrifugal would produce a better sugar from a badly mixed grain massecuite than a high speed centrifugal with a <u>very rapid acceleration</u>.

5. If this sugar is washed and separation made, the separation equipment must be such as to prevent washings from passing into the molasses.

The argument for the production of high purity "C" sugar in a raw house is the production of high purity seed grain, which improves both color and filtrability of the "A" and "B" sugars and more readily meets the demand of the refiners. At the same time, the quantity of non-sugars returned to process are materially reduced, as well as the quantity of "A" and "B" massecuites to boil.

The following results are typical of what can be stored by purging a "C" massecuite free from badly mixed or smear grain in high speed centrifugals.

UNWASHED AND WASHED "C" SUGAR
(Data secured from same crystallizer massecuite)

Unwashed "C" Sugar	Massecuite
Centrifugal RPM	1800
Acceleration rate in minutes	3.5
Massecuite, R.D.S.	94.0
Massecuite Purity	58.0
Cyclese (Mother Syrup) Purity	30.5
Molasses purity	31.0
Purity of unwashed "C" sugar	94.3
Temperature (^{o}C-^{o}F) of massecuite leaving crystallizer	36-97
Temperature (^{o}C-^{o}F) of massecuite as spun	51-124
Average cycle, load to load	11'

Washed "C" Sugar (94.3 unwashed purity)	"C" Massecuite
Polarization of washed "C" sugar	98.1
Purity of washed "C" sugar	98.8
Purity of "C" wash syrup	52.2
Average cycle, load to load	14'

SCREEN ANALYSIS OF WASHED "C" SUGAR

Retained on 14 mesh	0.0
Retained on 20 mesh	2.4
Retained on 28 mesh	5.2
Retained on 35 mesh	15.0
Retained on 48 mesh	28.6
Retained on 65 mesh	8.7
Through 100 mesh	12.4

Refinery Affination Magma

The main value of high speed centrifugals in the affininf of raw sugar is high capacity per unit. Also, less wash water is required to produce maximum purity washed sugar. As the grain characteristics of the raw sugar vary high speeds also make it easier to put out a uniformly washed sugar.

Factors affecting affination centrifugal operations are grain characteristics, viscosity, magma density and fluidity. High density magma with temperature control of the fluidity makes it possible to increase the centrifugal capacity by increasing the ratio of raw sugar to affination syrup in the magma. The chief difference between a massecuite and a magma is the great difference in actual weight per cu. ft., since in a magma there is not sufficient syrup present to completely fill the voids between the sugar grains. For example, a massecuite of 94 Brix may weigh 93 pounds to the cu. ft., while most affination magmas of 90 to 94 Brix will weigh 76 to 78 pounds per cu. ft.

Since the grain in raw sugar as a whole is fairly coarse and there is less syrup to remove from a magma, the purging qualities are less complicated than with massecuites and the quantity of wash water required to produce high purity washed sugar is reduced. High speed centrifugals, therefore, can operate at high capacity on very short cycles.

Comparison between low and high density magmas shows the advantage to be gained from a centrifugal capacity standpoint, as well as quantities of syrup to eliminate.

	AFFINATION MAGMA	
	90 R.D.S.	94 R.D.S.
Parts Raw Sugar in Magma	65	75
Parts Affination Syrup	35	25

Typical operating results obtained by processing high density heated magma in high speed centrifugals, are as follows:

Centrifugal RPM	1600
Acceleration rate, seconds	60
Affination Magma R.D.S.	94.0
Temperature Magma before heating (^oC-^oF)	53-127
Temperature Magma after heating (^oC-^oF)	68-146
Purity of Affined Sugar	99.6
Percent extraction of washed sugar on raw sugar crystal content	94.0
Average cycle, load to load	2'-30"

The length of the cycle is a function of the quality of the raw sugar. With all other conditions the same, lower speeds will reduce the capacity in approximately the same proportion, as the reduction in speed.

In normal affination operations, not more than six percent of the crystal content of the raw sugar should be dissolved. Graph III shows what influence the quality of raw sugar has on the quantity of excess affination produced.

WHITE SUGAR MASSECUITES

Grain characteristics of white sugar massecuites determines the centrifugal speed most adaptable. Coarse sugar massecuites would not warrant speeds over 1200 RPM, but with the fine grain massecuites high speed machines have a definite advantage, if all the benefits that can be obtained are considered. The processing of fine grain white sugar massecuites in high speed centrifugals promotes the following:

1. High capacity per unit.
2. Reduction in wash water requirements.
3. Drier sugar from centrifugals which minimizes drying operations.
4. Effective separation between green and wash syrups where more washing is required, such as in the lower purity white massecuites.

For maximum benefits, the cycle components should be automatically controlled. The acceleration should be rapid and massecuite fluidity and temperature maintained. Interval washing using superheated wash water is of very definite advantage.

When fine grain white sugar is produced, it is to much advantage to produce grain having uniformity of size and a maximum amount in the same mesh range.

Some special boiling tests were made to determine the effect of grain characteristics on centrifugal operations. Several boilings were made and averages taken. The centrifugal cycle components were regulated in each cane to try to obtain the same quality of sugar, moisture content and syrup separation. The effect on centrifugal capacity was determined by the total length of cycles in each case.

	A	B
Centrifugal RPM	1600	1600
Centrifugal acceleration, sec.	55	55
Massecuite, R.D.S.	92.8	92.6
Massecuite Purity	93.0	93.2
Massecuite temperature from pan (°C-°F)	86-187	86-187
Massecuite temperature as spun (°C-°F)	86-187	86-187
Purity of wash syrup	92.2	93.4
Average cycle, load to load	2'-55"	2'-25"
Moisture in sugar from centrifugals	1.06	0.82
Moisture in sugar as sacked	.035	.019
Quarts of wash water used	17	14
Pounds of dry sugar per cu. ft. of massecuite	36.0	38.9
Average temperature °C of sugar leaving centrifugals	70	78
Pounds of steam used on granulator	5-10	0
Temperature, °C, sugar sacked	45	33
Specific conductance of sugar	3.3	2.9

SCREEN ANALYSIS OF SUGAR

Plus 30 mesh	0.0	0.3
Retained on 40 mesh	4.1	10.5
Retained on 50 mesh	39.7	55.7
Retained on 60 mesh	28.4	24.2
Through 60 mesh	27.8	9.3

There was an increase in centrifugal capacity of 17% in "B" over "A". Also improvement in noted in sugar yield, syrup separation, sugar quality and temperature of sugar sacked. This improvement was entirely due to the better grain characteristics in the "B" massecuites and the grouping of a larger percentage of grain in one mesh range.

Graph IV illustrates the effect of acceleration rate and centrifugal speed upon the elimination rate of the greens. Nine cu. ft. of massecuite from the same strike

was placed in each basket before centrifugal accelerated and centrifugals operated for a period of 2 minutes without any washing, except in Case "D".

Curve "D" shows the effect on green elimination when four seconds of water was applied 20 seconds after centrifugal started to accelerate. The 4 seconds of water (approximately 3 quarts) increased elimination of greens over "C" where no water was applied by 11%.

The following results represent what can be obtained by high speed processing of white sugar massecuites, in conjunction with massecuite temperature control, rapid acceleration and interval washing.

WHITE SUGAR MASSECUITE

	High Purity	Low Purity
Refractometer Brix (RDS)	91.2	92.3
Purity	99.0	93.0
Temperature leaving pan °C - °F	87-188	87-188
Temperature as purged (entire strike)	87-188	87-188
Purity of greens	97.4	85.4
Purity of washings	No separation	93.7
Sugar from Centrifugals % moisture	0.80	0.87
Sugar produced, % ash	.004	.008

SCREEN ANALYSIS OF SUGAR

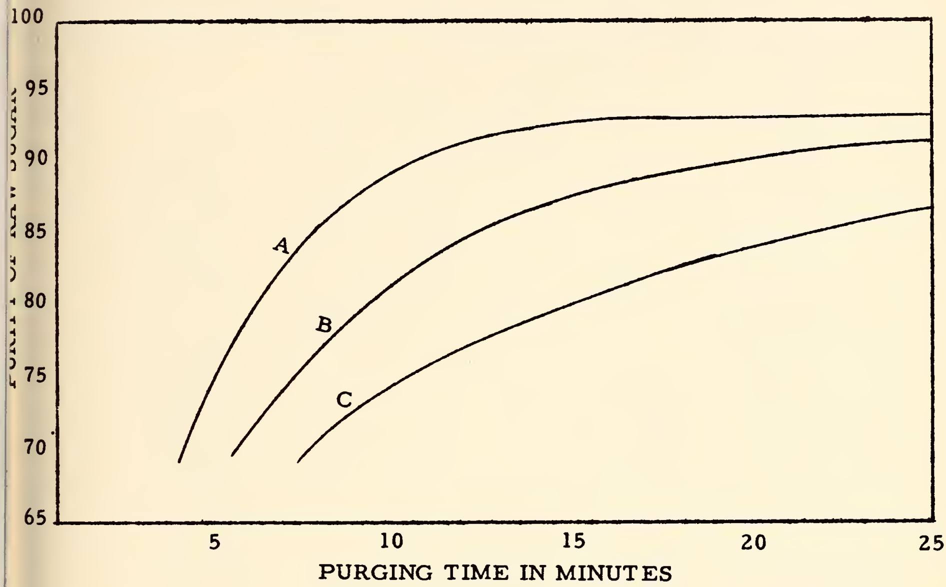
Percent on 30 mesh	2.0	0.4
Percent between 30-50 mesh	66.0	70.4
Percent between 50-70 mesh	20.2	16.2
Percent through 70 mesh	11.8	13.0
Average length of cycle, load to load	2'-25"	2'-45"

One of the main objectives of this paper is to try to point out to the processor the importance of grain uniformity in securing the best results from centrifugal operations.

The manufacturer of centrifugal equipment cannot control the grain characteristics but can furnish equipment that

will to a great extent, control the other factors that enter into centrifugal processing of sugar massecuites and magmas.

COMPARATIVE CURVES SHOWING INFLUENCE OF GRAIN CHARACTERISTICS UPON PURGING QUALITIES OF MASSECUITES



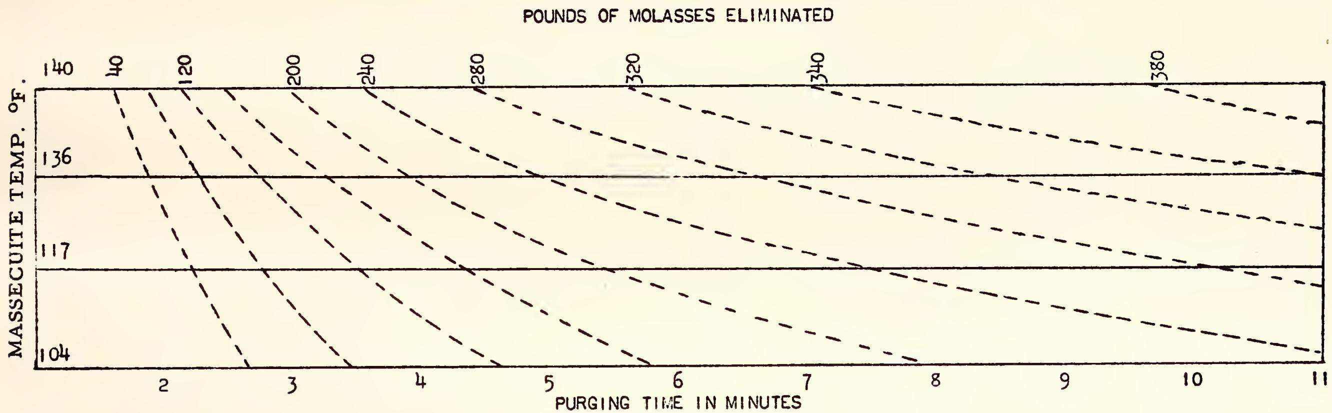
CURVE NO.	MASSECUITE BRIX	RDS	PURITY	MOLASSES PURITY	ESTIMATED GRAIN SIZE	SAT. TEMP.	VISCOSITY POISES
A	96.8	93.0	58.8	35.2	.40X.35 MM	131°F	365
B	96.9	93.2	59.1	34.9	.25X.20 MM	130°F	390
C	97.1	93.2	58.17	35.8	BADLY MIXED	127°F	375

NOTE: Massecuites represented by curves A and B were free from smear and grain quite uniform. Heavy skin formation on sugar wall, Curve C.

CENTRIFUGAL SPEED - 1800 RPM
BASKET - 40 x 24 x 6 INCH.

GRAPH 1

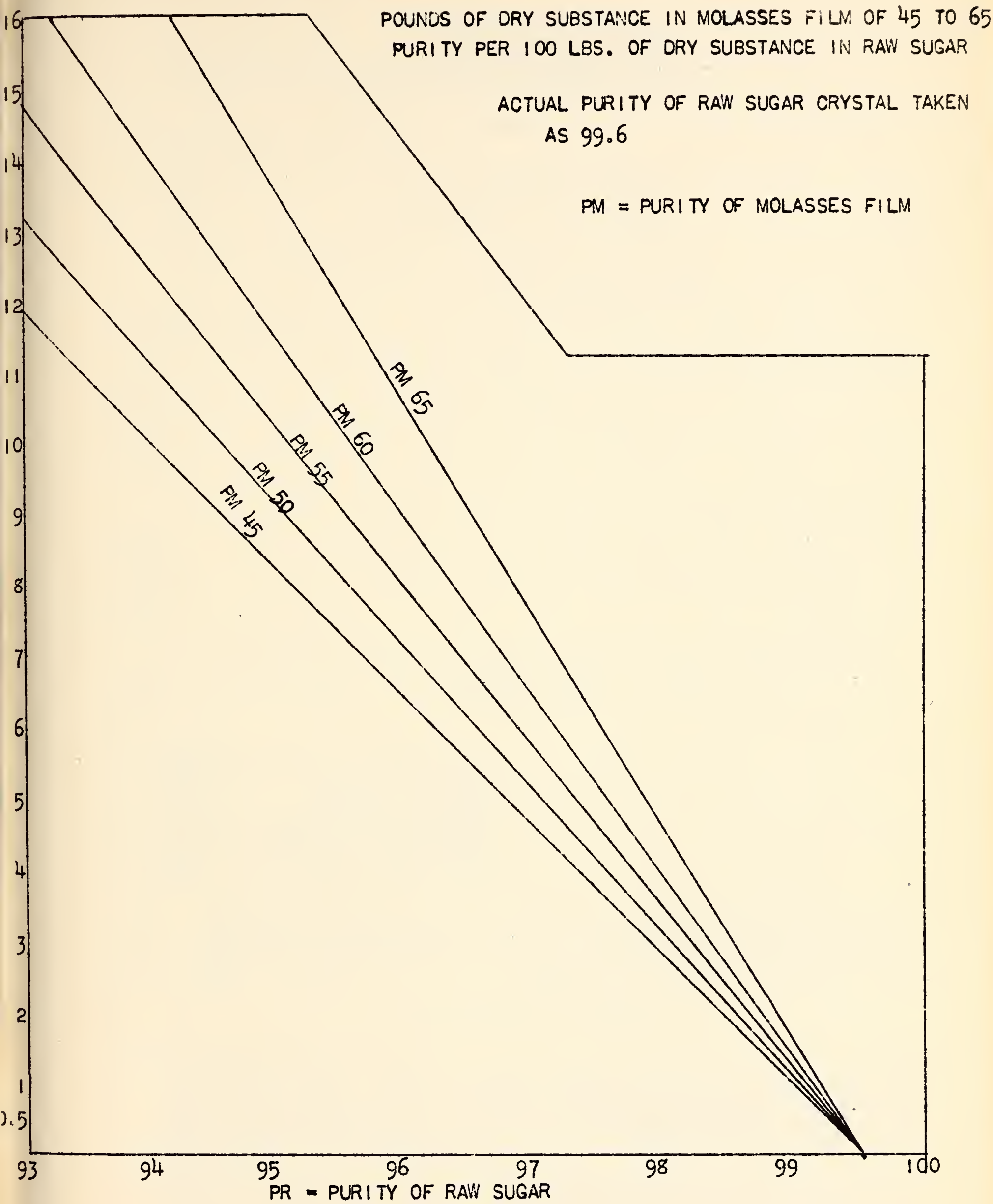
RELATIONSHIP BETWEEN MASSECUITE TEMPERATURE AND TIME FOR ELIMINATING THE SAME QUANTITY OF MOLASSES FROM DUPLICATE CHARGES (7.5 CU. FT.) THE CENTRIFUGAL SPEED REMAINING CONSTANT. (1800 RPM) BASKET 40 X 24 X 6 INCH.



NOTE: A 7.5 CU. FT. CHARGE PURGED AT 136° F. FOR 20 MINUTES AT 1100 RPM GAVE A SUGAR PURITY OF 88.4.

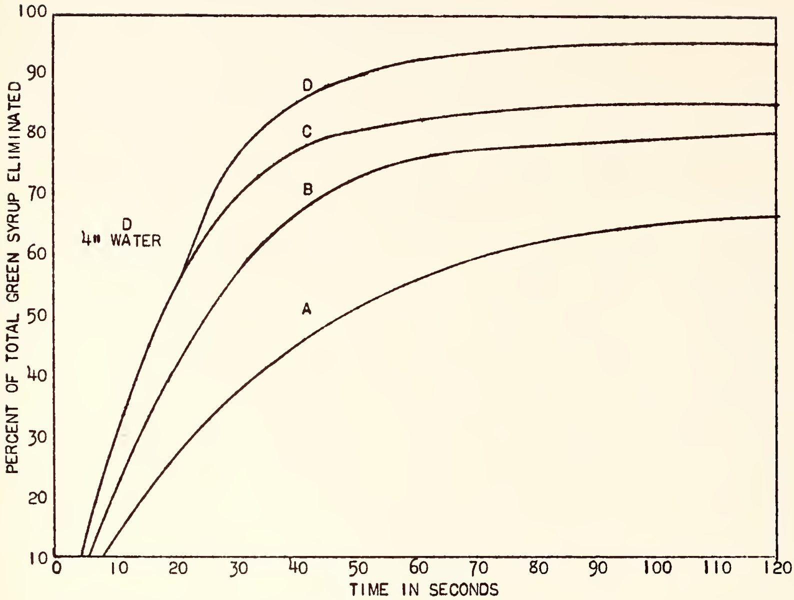
MASSECUITE		MASS. TEMP.		PURITY		TOTAL LBS.
		C.	F.	MOL.	SUGAR	MOL. ELIM'D.
BRIX	97.8	40	104	37.4	74.6	218
PURITY	60.6	47	117	37.4	86.2	309
CHARGE	7.5CF	58	136	37.5	90.2	362
SAT. TEMP.	135°F	61	142	37.6	92.0	392

GRAPH 11


POUNDS OF DRY SUBSTANCE IN MOLASSES FILM OF 45 TO 65 PURITY PER 100 LBS. OF DRY SUBSTANCE IN RAW SUGAR
ACTUAL PURITY OF RAW SUGAR CRYSTAL TAKEN AS 99.6
PM = PURITY OF MOLASSES FILM
PM 65
PM 60
PM 55
PM 50
PM 45
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.5
93
94
95
96
97
98
99
100
PR = PURITY OF RAW SUGAR

GRAPH III

WHITE SUGAR MASSECUITE
GREEN SYRUP ELIMINATION RATES
40 X 24 X 6 INCH BASKETS
9.0 CU.FT. MASSECUITE IN EACH CHARGE



MASSECUITE R.D.S.	92.6
MASSECUITE PURITY	93.0
MOTHER LIQUOR PURITY	85.5
MASSECUITE, LBS. PER CU.FT.	93.0
TOTAL POUNDS GREEN SYRUP	436

	A	B	C	D
MAXIMUM OF RPM OF CENTRIFUGAL	1050	1200	1600	1600
ACCELERATION TIME TO MAXIMUM SPEED	2'0"	45"	55"	55"
% OF TOTAL GREENS ELIMINATED IN 2 MINUTES	68	82	86	95

TESTS REPEATED AND SUGARS WASHED

	A	B	C	D
START OF WASHING AFTER ACCELERATING	45"	45"	55"	20"-55"
% OF TOTAL GREENS ELIMINATED AT START OF WASHING	49	72	82	55 - 93
CENTRIFUGAL RPM START OF WASHING	750	1200	1600	550-1600
TOTAL WASHING TIME IN SECONDS	25	21	18	15
SECONDS SEPARATOR TRIPPED AFTER START OF WASHING	15	12	10	START OF 2ND WASH
PURITY OF GREEN SYRUPS (WITH SOME WASHINGS)	87.9	87.2	86.6	85.8
PURITY OF WASHINGS	91.1	92.0	93.1	94.1

GRAPH IV

THE COST OF TRASH TO THE SUGAR FACTORY

by W. S. Daubert

Presented at the Annual Meeting, Houma, Louisiana
February 12, 1948

The trash situation is very much like the weather for as Mark Twain once said, "Everyone talks a great deal about it, but no one does anything about it." Nevertheless, in the writer's opinion it is one of the most serious problems that has faced factory owners and operators for many years. One of the most discouraging things about it is that there seems no possibility of it becoming any better and for several years it has become worse each year.

At one time a few years ago the larger growers, whose places were mechanized sent in trashy cane, but the smaller shippers who cut and loaded cane by hand usually delivered fairly clean cane. Now, even the smaller shippers are sending in trashy cane.

The money losses to the factory caused by trash are much greater than one would believe possible without careful thought. It is true that the weight of the trash, less 3 percent, can be deducted and at first thought it would appear that this deduction of the weight of trash would compensate for the loss. This is only beginning. It is merely deducting from the material delivered a portion of a foreign material that is not cane and under no conceivable idea has any place in a load of cane except that it costs the grower of cane money to remove it and is much easier to send to the factory with the cane than it is to leave it in the field where it belongs.

We can consider the losses caused by the trash under several points.

1. The cost and effort of taking trash samples and the inability of obtaining the total amount of trash by present methods of sampling.

2. Slower grinding rates on the mill due to milling the greatly increased weight of fiber.

3. Actual loss of sugar caused by trash absorbing juice and carrying it away in the bagasse; loss of sugar caused by the inability to lower the sucrose in bagasse in trashy cane to that of bagasse from clean cane; loss in sucrose in bagasse due to the larger amount of bagasse per ton due to the inability to lower moisture in bagasse from trashy cane.

4. Loss in grinding rates due to the inability of the clarifiers to handle the juice from trashy cane.

5. Loss of sucrose due to the greatly increased amount of mud made and loss of sucrose due to the necessity of ditching mud on liquidations and during operations when conditions are extreme.

6. Loss of sucrose in final molasses due to the inability to reduce the purity of final molasses.

7. Freight paid on trash.

8. Actual cost of grinding trash.

9. Greatly increased wear and tear on machinery.

In considering these losses, we can assume a hypothetical factory grinding as a normal state 100,000 to 125,000 tons of cane; it had a peak capacity of 2000 tons a day and including lost time its actual daily grinding average of 1700 tons per day and ground 100,000 tons of cane in 60 days under average weather conditions. It turned out a bagasse of 46 moisture and 2.50 sucrose and the final molasses had an average purity. It employs 150 men during grinding and has a base rate of 50 cents per hour and an average rate of 57-1/2 cents per hour. Average freight on cane is 55 cents per ton. It showed an average undetermined loss on cane of about .18. Before the days of trash this was a well operated smoothly working factory.

Let us look at the same factory today and assume that no major changes to increase capacity have been made. It now has a peak capacity of about 1750 tons and an actual grinding average of about 1400 tons per day. It handles cane with a total average trash of 10% of which 7% is deductible and grinds 100,000 tons of cane now in 70 days of which 10,000 tons are worthless trash. It now turns out

bagasse of 50% moisture and 2.75 sucrose by the hardest and a final molasses of 32 purity. Its undetermined loss on cane is now .30.

Let us consider the cost of some of the items listed above.

1. The cost of taking trash samples varies considerably from factory to factory. Some use as low as two men, others as high as seven men. Assuming an average of 4 men the cost per day at the minimum wage is $24.00 and for 70 days is $1680.00. The fact that the present method of taking samples by hand from a truck, cart, or railroad car gives low figures can hardly be disputed. In taking a sample from a matted mass of trashy cane by hand it is practically impossible to pick up the cane without pulling some of it from the bundle. This leaves a portion of the trash behind. However, this is an intangible item and will not be considered.

Items 2 and 4 will be considered together as both are causes of slow grinding rates. This factory now takes 10 days longer to grind 100,000 tons than it did with clean cane. Each day means 150 men at 57-1/2 cents per hour or $862.50 per day. Extra fuel, oil, and other grinding costs will bring this daily cost to $1100 and for 10 extra days will mean $11,000.

3. Trash has an average moisture content of approximately 50% over the season. It will be considerably higher during damp weather and much lower when the trash is dry. However, it can be assumed that the weight of trash will appear as bagasse practically unchanged in weight. One hundred thousand tons of cane with a trash content of 10% were ground so that 10,000 tons of trash entered the mill and came out as 10,000 tons of bagasse. It had no sucrose when it entered and now has 2.75% or a total 275 tons of sucrose. Assuming that 80% of this sucrose had been recovered as 96^{o} sugar, 220 tons sugar would have been saved and at a net value to the factory of 6 cents per pound would be worth $26,400. The other 55 tons of sugar would show up in molasses and at 4.0 pounds of sucrose per gallon would yield 27,500 gallons of molasses which at 24 cents per gallon or $3850.00 makes a total of $30,250 which has been robbed by the trash from the cane paid for.

5. The amount of mud produced by trashy cane is considerably greater than that produced by clean cane. In the days when presses were used the press cake averaged from 30

to 35 pounds per ton. Oliver cake including bagacillo ran about 50 pounds per ton of cane. Figures from actual measurement show Oliver cake running about 100 pounds during dry weather to 200 pounds during wet weather. Using 125 pounds as average this is 75 pounds more than the cake from clean cane. Assuming that 50% is bagacillo there are 37.5 pounds more cake per ton and at 2% sucrose is a loss of .75 pounds sugar per ton or 75,000 pounds per season. In sugar and molasses this sucrose would have a value of $4200.

The practice of ditching mud has unfortunately become quite common in the past few years. This is a misnomer for when mud is ditched it is not mud but dirty juice for it is only when the mud will not settle is it ditched. When the practice is once started, it is hard to supervise the workmen carefully enough to prevent them from using this method as an easy way out of clarifier troubles. In the writer's opinion this is the cause of the high undetermined losses now so common. He has seen reports showing such losses from .40 to .60 on cane.

Assuming our hypothetical factory has a loss of .30 where the average before was .18. This is an increase of .12 on cane or a loss of 2.4 pounds of sugar per ton worth 14.4 cents or $14,400 on a crop of 100,000 tons.

6. Our assumed factory made 6.5 gallons of molasses at 32 purity where the purity had been 28 before. With molasses at 24 cents the value of this product to the factory is 16 cents per gallon or $1.04 per ton. If this molasses were reduced to 28 purity it would yield 3.6 pounds of 96° sugar and 6.12 gallons molasses. The value of the sugar would be 21.6 cents and the molasses 97.9 cents or a total of $1.195 or a difference of 15.5 cents per ton or $15,500 on a crop of 100,000 tons.

7. As our assumed factory paid 55 cents per ton for freight and there were 10,000 tons total trash it spent $5,500 for hauling in to the factory an item not only worthless but the cause of great losses.

8. Our factory ground 100,000 tons of trashy cane. Of this 10,000 tons were trash. At a grinding rate of 1400 tons this factory spent a little over 7 days of its grinding time grinding trash alone. At $1100 per day this cost $7,700.

9. This item increased wear and tear on machinery, is hard to figure, but the amount is very large. Carrier

chains, knives, mill rolls, intermediate carriers, trash elevators, juice pumps, pipe lines-in fact every piece of equipment that comes in contact with cane, raw juice, mud or muddy filtrate wears out with startling rapidity. In the writer's opinion $10,000 a year is a fair estimate of increased cost due to excessive wear.

A recapitulation of these losses is:

Sampling trash	$ 1,680.00
Decrease in grinding rate	11,000.00
Loss of sucrose in trash in bagasse .	30,250.00
Increase in press cake.	4,200.00
Increase in undetermined loss . . .	14,400.00
Loss in higher purity molasses . . .	15,500.00
Freight on trash	5,500.00
Cost of grinding trash	7,700.00
Excess wear and tear on machinery.	10,000.00
	$ 100,230.00

These figures show that the losses caused by trash are tremendous.

With the very good possibility of the price of sugar and molasses declining, wage rates being increased considerably, and the cost of replacements staying at their present high level or even higher the picture looks rather dismal.

Some method of getting cleaner cane must be developed and this is a problem for the best brains in the industry to work upon.

TRASH MEASUREMENTS AT LOUISIANA SUGAR FACTORIES

by C. W. Stewart, Audubon Sugar Factory

Presented at the Annual Meeting, Houma, La., Feb. 12, 1948

Trash is not a temporary condition but a permanent problem for the Louisiana sugar industry. The gravity of this problem increases as mechanization expands. Mechanization will continue to expand and with the present type of cane harvesting equipment and methods, the cane trash problem, if not corrected, will become an increasing burden on the Louisiana sugar factories.

In the consideration of trash measurements I propose that cane trash be defined as any material delivered to the sugar factory in conjunction with the sugar cane from which no sugar is obtainable. In other words any material other than the well cleaned properly topped stalk of sugar cane. This material or trash may consist of cane leaves, tops, roots, soil, weeds, grass, etc.

Trash exerts a detrimental effect on the entire sugar factory operation. In support of this statement I would like to present: a, the weight effect of trash in cane; b, effect of trash on mill capacity; c, increased milling losses caused by expanded bagasse production due to trash; d, introduction of impurities into the process when trashy cane is milled.

a. The weight effect of trash in cane. The general procedure for trash determination is as follows: cane delivered to the mill is sampled and after separating trash from cane a percentage is established by weight differences. After this percentage is established a corresponding deduction is made for the trash found to be present.

It is very important that these tests be made as near correct as possible. The collection of the sample is the difficult part of the operation. If a sample is pulled from a closed bundle of cane most of the trash is stripped off and remains in the bundle. The size of the sample and the method of collecting it are very important in securing correct results.

The chains holding the bundle of cane should be opened and the sample removed very carefully either by hand or by the use of a small grab. If the hand method is used two

men are required to do the sampling properly. In a publication entitled "Sugar Cane Trash Investigation 1945" in Engineering Experiment Station Bulletin No. 9, a grab 72" wide is recommended as possibly suitable for this operation.(1) The weight of the sample should be 100 to 125 lbs. as shown in tables submitted in the same publication. The weight deduction for trash is the only measurement of it recognized, so far, by the industry. I have no data showing to what extent this recognition is practiced.

The percentage of trash is reflected in the sucrose extracted percent cane. This is shown in a publication appearing in the Sugar Bulletin, March 15, 1943, by Etheredge and Henry. In the data submitted average cane of 1.62% trash was milled and the results compared with those obtained when milling cane of 10.59% trash. In this comparison we find a decrease in extraction of sucrose percent cane from 10.94 in average cane to 9.79 in the trashy cane. These figures were made on the basis of true sucrose. This difference represents a loss of about 10% in sucrose extracted percent cane. In this case if a 10% trash deduction were made it would only compensate for the sucrose lost percent cane at this point and leave no balance to meet other factory sucrose losses caused by milling trashy cane.

b. <u>The effect of trash on mill capacity</u>. This is a measurement of trash that, so far, has not been recognized by the sugar cane industry of Louisiana. Mill settings are calculated on the amount of fiber to be passed between the rolls. If we assume that our mill settings are calculated on the basis of 14% fiber in cane, or to mill 280 pounds fiber per ton cane, and we get a drastic increase in the percentage of fiber, we experience mill chokes and a correspondingly reduced grinding rate.

In an investigation of trash by Robert Mason at the Louisiana State University in 1946(4) he found testing 12 samples of cane the average trash content to be 7.26%. This trash contained 65.90% fiber. Applying this data to our mill setting problem we find a ton of cane yields 145 pounds of trash at 65.9% fiber or 95.60 pounds fiber in the trash alone. The trash free cane, after deduction for trash is made, yields 259.7 pounds fiber at 14%. The fiber in the trash added to the fiber in the clean cane would equal 355.3 pounds fiber or an increase of 75.3 pounds per ton cane, which is 26.89% increase in fiber percent cane. On the basis of this calculation instead of milling cane of 14% fiber

we are actually milling cane of 17.77% fiber.
If milling cane of 7.26% trash will cause the fiber in cane to rise 3.77%, what would happen when milling cane of 10 to 12% trash as is so often the case. To overcome this milling difficulty, we have to alter mill settings, and in doing this we sacrifice extraction.

c. Increased milling losses caused by expanded bagasse production due to trash: It seems to be the general opinion of sugar factory management that an increased loss of sucrose occurs in the bagasse when milling trashy cane. The findings of research seem to agree with this opinion. The argument presented by management is that trash enters the mill with practically no sucrose and when discharged with the bagasse it has approximately 3.0% sucrose or the same sucrose content as the bagasse, of which it becomes a part. Research verified this opinion. Arceneaux and Davidson(1) found by experiment that the amount of sucrose lost in bagasse per ton of cane milled increased as higher percentages of trash were processed with the cane. Cane with no trash showed a loss in bagasse of 10.0 pounds sucrose per ton while cane with 7.5% trash had corresponding loss of 13.3 pounds per ton or an increased loss of 3.3 pounds per ton cane. This loss was shown on dry trash but on green trash the loss was considerably less, 1.9 pounds per ton cane. This condition may be explained by the difference in the absorption ability of the two types of trash.

d. Introduction of impurities into the process when trashy cane is milled. The type of trash milled with the cane greatly effect the quantity and quality of impurities introduced into the process. Green leaves, tops and soil are the chief offenders at this point of the operation. Soil or mud is delivered to the factory with the cane. In dry weather this type of trash represents a small percent of the total but during a wet season it becomes a major problem. In the case of unstripped or unburned cane the area, to which soil adheres, is vastly increased, and therefore an increased amount is delivered with the cane. During the milling operation a larger portion of this soil is washed off into the juice stream and sent to the boiling house. In some cases there is so much soil in the juice that a Brix determination is very difficult. I am of the opinion that juice weights which include varying quantities of soil will give erroneous mill extraction figures and also affect boiling house control calculations. My reasons for offering

this suggestion are that soil is an insoluble solid, adding weight to the juice, but in no way recorded by the analytical instruments. It would not affect a polarization determination by Horne's method nor will it affect a Brix reading if allowed to settle sufficiently for the Brix spindle to float above the mud. From these two determinations Brix and Polarization, the percent sucrose in juice is calculated. If a given weight of juice containing 5% mud by weight in suspension is multiplied by the percentage of sucrose it is found to contain, the weight of sucrose will be 5% in error. Example: 2000 pounds juice with 11% sucrose equals 220 pounds sucrose, but if this juice contains 5% mud the actual juice weight would be 1900 pounds and this at 11% sucrose would be 209 pounds sucrose instead of 220 pounds or an error of 5%.

The presence of mud in juice will, if no correction is made for it, be reflected in the undetermined losses shown on the factory manufacturing report. Mud continues to be offensive throughout the process. It has an erosive effect on pumps and pipe lines and has a tendency to slow down the clarification of juices. It also places an increased load on the filter station and in the case of continuous filters causes greater volumes of dirty juice to be returned for reclarification. The increased weight of filter press cake removes an additional amount of sucrose from process as a definite loss.

Impurities introduced into process by leaves and tops differ from soil in that they are soluble solids, and to a great extent, non-sugars.

Etheredge and Henry[2] found that the presence of these impurities affected the polarization of the juices. On cane of 1.68% trash using direct polarization, the sucrose extraction was shown by them, in the test made, to be 93.23% and from cane of (10.59%) trash 93.07%, a difference of 0.16%. On the true sucrose (clerget) basis, sucrose extractions on the two types of cane showed a difference of 0.54% in favor of the clean cane.

As an additional proof of the increased amount of impurities extracted from trashy cane they call attention to the drop between purities of mixed and residual juices. In the clean cane a drop of 3.95 points was noted while in the trashy cane they find a drop of 6.15 points.

Arceneaux and Davidson [1], in their investigations, report considerable drops in the purities of mixed juice as the amount of trash in the cane increased, dry trash showing

a drop of 1.68 where 7.5% trash was milled or 0.217 points for each 1% of trash. The green trash had a more pronounced effect in that the purity drop was 5.43 or 0.302 points for each 1% trash. They also show that the increased amount of impurities in the juice is indicated by an increase in the ash content. From their data we find an increase of 8.7 pounds ash per ton cane when 7.5% dry trash was used and 38.9 pounds per ton cane with 18% green trash.

The extracted impurities in the form of soluble solids pass through the entire manufacturing process. They slow down clarification and in conjunction with the mud demand a reduced grinding rate. This is true because of the increased time required at both clarification and filtering stations.

In some cases attempting to maintain a set milling rate, some muds and unsettled juices are thrown to the ditch by the operators. This causes a definite loss and appears as undetermined.

These impurities increase the viscosity of the syrups and molasses. This increased viscosity frequently is sufficient to retard the crystallization of sucrose and is reflected in higher sucrose in final molasses losses.

In the literature and in practice I find nothing to recommend the milling of trash with cane. For profitable results the trash must be kept out of the mill. The Louisiana sugar industry has solved difficult problems before and I am sure this one will be overcome.

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Presented in round table discussion on "Evaporator Cleaning" before the Manufacturing Section of the American Sugar Cane Technologists' Association in Houma, Louisiana, on July 8, 1952.

THE IMPORTANCE OF THE PURITY OF NORMAL JUICE IN THE MANUFACTURING OF SUGAR IN LOUISIANA

by Robert H. Littell

Presented at the meeting of the Manufacturing Section, Houma, Louisiana, June 22, 1949.

One of the most important quality factors that determines the successful, or non-successful, operation of a sugar factory is the purity of the material being processed. It is the basis of control of the manufacture of sugar throughout each station in the factory from the mills to the filling of the bags with the finished product.

The expression purity of a sugar product is defined as the percentage of sucrose (Pol) in the solids or Brix. In this study the term "Purity" is used for the apparent purity, and all further remarkd will be confined to this term and that of the purity of normal juice.

In the manufacture of sugar with juices containing purities that are concomitant with their respective sucroses, in contrast to those that are not, we can expect the following results, (1) better clarification, (2) less lime required, (3) more rapid pan and centrifugal work, (4) reduction of low grade massecuites, (5) less inversion of sucrose, (6) maintenance of factory capacity, (7) lower fuel, and (8) less fouling of heating and evaporating equipment. There is no doubt, also, that the morale of the personnel in the factory is affected whenever the purity of the materials being processed is normal, because when satisfactory work is done the men are contented. And when poor material is being worked, dissatisfaction and lack of interest prevail among the personnel.

As the purities that are comparable with the sucrose in the normal juice do not present such a problem as the sub-normal or low impurities do, it should be appropriate to note in passing some of the contributory causes of low purity juices of sugar cane in Louisiana.

1. Staleness of cane.
2. Harvesting of immature tops of cane.

TABLE NO. 1. Purities of Normal Juice Expected at Various Levels of Normal Juice % Sucrose

NORMAL JUICES	
Column 1 % Sucrose	Column 2 Expected Purity
9.5	68
10.0	71
10.5	74
11.0	75
11.5	76
12.0	77
12.5	78
13.0	79
13.5	80
14.0	81
14.5	82
15.0	83
15.5	84
16.0	85
16.5	86
17.0	87
17.5	88
18.0	89
18.5	90

SOURCE: The above relationship was established by comparison, crops 1935, 1936, and 1937, and was used as the basis from which to compute the A. A. A., "Commercially Recoverable Sugar Determination for Louisiana Sugar Cane", dated April 26, 1938.

In Table No. 2 are the values of the Winter and Carp Formula of purity ranges from 68 to 90 percent. These values show the percentages of total sucrose in juices of various purities theoretically recoverable in sugar with a Boiling House Efficiency of 100.00 percent. The effect of purity on the availability of sugar of the juice is obvious.

3. Immature cane.
4. Frozen cane.

Though it is not within the sphere of this discussion to elaborate on what remedial measures would be required to prevent, or minimize, these causes of low purity juice, we must admit that Nos. 1 and 2 can be controlled and practically eliminated with proper supervision. In regard to No. 3, immature cane, though the availability of sugar is lower, it has been observed that low purity juice from fresh immature cane is not as difficult to process as that of low purity juice emanating from cane that previously possessed a higher purity juice. The drop in the purity of juice from frozen cane can be retarded by the lowering of the knives as the upper joints of the cane deteriorate.

What is of paramount interest to the processor is the effect of purity on the various sucroses. It would be avvisable at this point to familiarize ourselves with the information contained in Tables Nos. 1, 2, 3, and 4.

In Table No. 1 are the corresponding sucroses and purities that were used as the basis from which the A. A. A. "Commercially Recoverable Sugar Determination for Louisiana Sugar Cane" was computed in 1938. This may be called the "Yardstick" of the normal purity for the various sucroses. During the past season there was one sugar factory whose season's average of normal juice was Sucrose 12.12 percent and purity 73.44 percent. The purity should have been 77.2 percent, a difference of 3.76 percent, for a sucrose of 12.12 percent. In pounds of raw sugar this difference amounts to approximately four pounds of raw sugar per ton of cane. In terms of dollars at the existing price of raw sugar on a 100,000 ton crop this loss would amount to over $22,000. Added to this tangible figure, which can be expressed in terms of dollars, is the loss of capacity with its subsequent increase in operating cost, when processing juice of low purity. Any decrease in factory capacity prolongs the harvesting season thereby increasing the hazard of a freeze.

TABLE NO. 2. Values of the Factor 1.4 - (40.0 divided by purity) X 100 for Coefficients of Purity Ranging from 68 to 90

Column 1 Purity	Column 2 Factor
68	81.12
69	82.03
70	82.86
71	83.66
72	84.45
73	85.21
74	85.96
75	86.67
76	87.37
77	88.05
78	88.72
79	89.37
80	90.00
81	90.62
82	91.22
83	91.81
84	92.38
85	92.94
86	93.49
87	94.02
88	94.55
89	95.06
90	95.56

Table No. 3 shows the comparison of actual purities and expected purities experienced in Louisiana Sugar Factories during the past twelve years. It is important to note during the past six seasons the decrease in the actual purity with that of the expected purity. This difference of purity accounts for the reduction of yield of approximately two pounds of sugar per ton of cane on a calculated basis. However, we know with the attendant lower Boiling House Efficiency in processing low purity juices the loss is greater. This decrease in purity of the past six seasons can be attributed partly to the present methods of harvesting cane and partly to the complacence of the cane purchaser in the acceptance of poor quality cane.

TABLE NO. 3. Average of All Louisiana Factories Each Year, 1937 through 1948 for the Following Items:

Column 1 Crop Year	Column 2 Normal Juices % Sucrose	Column 3 Actual Purity	Column 4 Expected Purity	Difference in 96 sugar
1937	11.76	76.26	76.52	
1938	12.50	77.40	78.00	
1939	12.63	75.53	78.26	
1940	11.93	77.62	76.86	
1941	12.14	76.69	77.28	
1942	12.70	77.63	78.40	
1943	12.39	76.10	77.78	
1944	11.93	75.03	76.86	
1945	11.86	75.25	76.72	
1946	12.31	76.74	77.62	
1947	12.33	76.49	77.66	
1948	11.91	75.14	76.82	
Simple average 1937 thru 1942	12.28	76.86	77.55	.85 lb.
Simple average 1943 thru 1948	12.12	75.79	77.24	1.80 lb.

SOURCE: Columns 1, 2, and 3 Ref #1
Column 4 from Table 1

Table No. 4 explains the procedure by which the attached chart was formulated. This chart correlates the sucrose that correspond to various purities of a given sucrose on a yield basis. In the calculation of the available sugar per ton of cane a Normal Juice Extraction of 73.66% and a Boiling House Efficiency of 98.00 percent were used, as it was found that with these figures the results checked closely with those of the "Commercially Recoverable Sugar, Raw Value, per ton of Sugar Cane" Table of 1948, with the exception of yields from purities below 75.0%. Below that level there were slight discrepancies which werenegligible. However, the purpose of the chart is to present a method whereby corrected sucroses from

abnormal purities can be readily determined.

TABLE NO. 4 Sucroses Corresponding to Various Purities of a Given Sucrose on a Yield Basis

Column 1 Normal Juice Sucrose	Column 2 Normal Juice Purity	Column 3 Pounds 96 Sugar per Ton of Cane	Column 4 #96 Sug/TC Loss or gain from Std.	Column 5 Corresponding Sucrose on Yield Basis
12.00	68.6	147.4	Loss: 11.5	11.26
12.00	69.8	149.2	9.7	11.38
12.00	71.0	151.0	7.9	11.49
12.00	72.2	152.7	6.2	11.60
12.00	73.4	154.3	4.6	11.70
12.00	74.2	155.4	3.5	11.78
12.00	74.6	155.9	3.0	11.80
12.00	75.0	156.4	2.5	11.84
12.00	75.4	156.9	2.0	11.87
12.00	75.8	157.4	1.5	11.90
12.00	76.2	157.9	1.0	11.94
12.00	76.6	158.4	0.5	11.97
12.00	77.0	158.9	0.0	12.00
12.00	77.4	159.4	Gain: 0.5	12.03
12.00	77.8	159.5	1.0	12.06
12.00	78.2	160.3	1.4	12.09
12.00	78.6	160.8	1.9	12.12
12.00	79.0	161.3	2.4	12.15
12.00	79.4	161.8	2.9	12.18
12.00	79.8	162.2	3.3	12.21

NOTE: In the calculation of the available sugar per ton of cane a Normal Juice Extraction of 73.66% and a Boiling House Efficiency of 98.00 were used.

In conclusion, with the decline in prices of sugar and molasses it is very essential that every effort be made to assure the processing of juice from cane with a normal purity. This will be one step towards aiding the raw sugar factory to operate on a profitable basis and attaining economic security.

REF: #1 - P. M. A. "Recapitulation of Final Manufacturing Reports of Louisiana Sugar Cane Factories."

PRESENT DAY MILLING PRACTICES IN LOUISIANA

by E. C. Niestrath, Chief Engineer, Service Foundry, Inc.

Presented at the Meeting of the Manufacturing Section, Houma, Louisiana, June 22, 1949.

Not many years ago it was the generally accepted idea that sugar cane had to be ground at a slow rate in order to permit the juice to drain from the rollers. This idea has been proven quite erroneous and we find today that mills are running at speeds heretofore unheard of and grinding almost fantastic capacities of tough, high fiber cane. Whether the speeds and capacities now in vogue are the maximum attainable is yet to be proven by experiment, but it does seem reasonable to believe that there exists a limit beyond which it is neither practical nor economical to go, as the cost of maintenance and repair might more than offset the benefits derived from the higher grinding rate.

Although higher speeds have a great influence on the grinding rate, it is not to be taken for granted that merely increasing the speed of the tandem will bring about a desired increase in capacity. Many other factors such as the fiber content and type of cane, the roll settings and grooving, the preparation of the cane, and the careful co-ordination of all the units in the tandem from the cane knives to the last mill, also affect capacity.

Many of these factors are more or less intangible and cannot be clearly defined. The determination and selection of the proper size and type of roll grooving for a given capacity, for example, is something for which there exists no workable formula or rule, experience being the only basis so far developed. There existed at one time, quite a wide variation in the grooving employed by different mills. Through closer cooperation and more widespread exchange of ideas between operators this difference has been narrowed down so that at present the most widely used mill roll grooves are 1" on the front mills and 3/4", 5/8". and 1/2" on the back mills. A few mills use 1-1/2" and 2" pitch grooves for the first mill, but where the cane is properly prepared by knifing and by adequate crusher work 1" pitch should be sufficient for this purpose. Where poor crusher work (or no crusher) is available, larger pitches are

essential as in such cases the first mill must perform the duty of the crusher as well as the first mill. These larger pitches would also be indicated where the amount of cane to be ground is extremely high and where large and sturdy front mills are available. One-inch pitch grooving could also be used to advantage on the second mill, with the balance of the mills grooved 5/8" or 1/2" pitch, provided there are four or more mills in the tandem. It would also be practical to use 1" pitch grooving on the first mill only, with the balance of the mills grooved 1/2", 5/8", or 3/4" pitch. The determining factor in either case would be the interchangeability of the rolls from one mill to another and the amount of spares to be used. In factories where all of the mills in the tandem are of the same size and have the same journals, interchangeability and spares offer no problem, but there are not very many mills in Louisiana which have such equipment, hence it is necessary to select grooving with an eye to economy of spares.

The angle of the grooves should be either 50° or 55°, the fifty-degree angle being preferable and the most commonly used. A few mills are using, or have tried using, 40° and 45° grooves, but these while entirely satisfactory on softer, cleaner canes such as ground in the tropics, are entirely too pointed for practical economy when grinding hard, high fiber, trashy, and dirty canes such as are being ground in Louisiana, and result in excessive roll wear and tooth breakage. The 50° groove is preferable because it is fairly deep and yet not too pointed for severe service, nor too blunt.

Longitudinal hook or feed grooves on the cane and bagasse rolls as well as the top rolls are most essential, and recent experiments have pointed out that they have a tremendous influence on capacity. Indications are that these hooks can be very closely spaced, the finer the pitch the greater the efficiency up to certain limits, the limits being the wear and breakage on the extremely small hooks together with the increased cost of maintenance.

To facilitate the flow of juice from the rollers, Messchaert juice grooves should be used in the cane rolls of all mills. They would also be advantageous in the bagasse rolls of the front mills of the tandem and are in fact used quite extensively in this manner in Cuba, but when so employed, greatly increase the amount of trash in the juice pans. Most operators object to them because of this dirt and trash, but

when adequate means are provided for removing this dirt they can be very beneficial, as they provide excellent means for draining the juice from the bagasse roll. The most efficient and practical spacing for these grooves is 3" pitch, as smaller pitches decrease the drainage surfaces.

Grooves or teeth on the heels of turnplates, extending part way into the grooving of the bagasse rolls, greatly reduce the amount of falling trash on mills using coarse grooving, but care must be exercised not to make the opening between the heel of the turnplate and the bagasse roll too small and thereby restrict the flow of juice. It is a good rule to make this opening 1/2" on all mills, and to make use of grooves on the turnplate heels to reduce the amount of falling dirt.

In determining roll settings it must be remembered that there exists a rather definite relationship between the opening of the cane roll and the bagasse roll. The ratio of these openings should be about 1.75 to one for the first mill, increasing to about 2 or 2.25 to one for the last mill. In other words, for the first mill, the area of the opening for the cane roll should be 1.75 times the opening for the bagasse roll, and on the last mill, the cane roll opening should be about twice that of the bagasse roll opening, but in all cases the size of these openings should be governed by the opening of the cane roll. Many mill operators are inclined to set the bagasse rolls too close with the result that the mills are thrown out of balance when the mat of cane passes through the rollers.

A matter of extreme importance and one which is generally overlooked is that the roll and turnplate settings must be maintained by frequent adjustment and inspection as mill work progresses. Immediately a mill starts operating there commences an action which tends to destroy the original setting and it is only by frequent adjustment that these settings can be held.

Quite a few mills are of a type in which the turnbeam, or turnplate supporting bar, projects through an opening in the housing, the adjustments being made by wedges and shims. Most of these housings were designed many years ago and were intended for grinding much smaller capacities than they are now being called upon to handle. They are usually quite troublesome to the operating engineer because of the difficulty in keeping the turnplate in proper adjustment. In the case of these old style housings, this adjustment usually consists of moving the turnplate forward, thereby changing the relationship between the heel of the turnplate and the top and bagasse

rolls, thus throwing the mill out of balance. In the case of the rocker type turnplate, such as the kingboltless type mills and on some of the newer king-bolt type mills, this adjustment consists of a rocking or tipping action, permitting the turnplate to be tipped until the nose comes again in contact with the front roller, without greatly changing the relationship between the heel and the top and bagasse rolls. In a number of instances the wedge adjusted turn beams have been replaced by the rocker type through the use of attachments fastened to the existing housing.

The protection of the shaft journals of the mill bottom rolls has always been a problem, and many of these journals show effect of contamination of the lubricating oil caused by juice squirting from, or draining off, the ends of the rolls. In an effort to overcome this difficulty, splash plates, or, what are sometimes called juice flanges, or juice guards, were developed. These consist of thin plates, about 3/16" or 1/4" thick, approximately the same diameter as the bottom roll, mounted on the ends of the rolls so that they overlap the flanges of the top roll. By overlapping the flanges they form a shield and keep the juice from squirting on the journals.

Proper preparation of the cane for the mills is important to capacity and extraction. The initial step of this preparation actually takes place in the field, but, upon reaching the mill the preparation consists of washing, proper knifing and proper disintegration by crushers or shredders. A good two roller crusher should extract no less than 60 to 65 percent of the normal juice in the cane, at the same time disintegrating the fiber so that it will readily enter the first mill, Such crusher for the purpose of good operation and proper functioning should be of larger diameter, or at least as large as the first mill rolls, and should run at a slightly faster surface speed in order to compensate for the loss of volume due to the discharge of th juice. Many crushers now operating in Louisiana were converted from the Krajewski type to the V-groove type in order to secure the benefits of the increased extraction obtainable with the V-groove type, but this conversion has of necessity limited the size of the rollers so that these crushers are generally smaller than the mills and result in more or less trouble with feeding, especially when grinding the short fiber canes. As is the case with the mill rollers there is no formula or rule for determining the size and angle or crusher roll grooving, but experience in the

past few years has indicated that an abundance of hook or chevron grooves is an asset. In many instances the feeding qualities of old rolls have been improved by adding smaller hook grooves between the large hooks originally cut in the rolls.

Different devices have been made in an effort to overcome the difficulties encountered with feeding crushers. Many years ago, the U. S. Patent Office granted patents for a reciprocating type pusher feeder operated from pistons, or from a multiple crankshaft. Various types of feeder rolls have been tried, and recently one operator in Louisiana installed in the bottom of his crusher chute, an apron type feeder, similar to an intermediate carrier apron. All of these have operated with more or less success, depending upon the type and size of crusher, the location and angle of the cane chute, the height of the cane carrier head shaft and the type of cane, all of which are factors influencing and affecting crusher feeding qualities. Generally speaking, when the crusher rolls are large enough, and properly grooved, the cane chute is placed at the proper angle and height from the bottom roll, the feeding of crushers should not be a problem, but all crushers, whether small or large, have more trouble in handling the short fibre cane than they do with the long fibre cane.

Proper knifing is an asset in handling the present day high fibre cane and where possible a double set of knives is recommended. These knives should be kept sharp at all times by frequent sharpening or renewal of the blades, and should be driven by prime movers sufficiently powerful to drive them thru peak loads or chokes which might be caused by uneven feeding at the feeder table. Obviously, there is nothing that will hamper capacity more than constantly having to stop the mill to relieve chokes at the cane knives.

Most mills are now equipped with hydraulic top caps, thus providing for a greater or less degree of floating of the top roll which is so essential to good mill work. Since many of these top caps have been adapted to old mills and are being used in conjunction with the existing short, squatty top roll top boxes, the degree of free floating is questionable as these short top boxes have a tendency to bind or jam against the sides of the housing jaws. When

such binding occurs, enormous pressures are exerted before the top roll begins to lift, and in some cases no lifting whatever occurs. Increasing the height of the top boxes and lengthening their sides, so as to reduce this binding, has proven to be an important step toward insuring free floating of the top roll.

The development of the air loaded hydraulic accumulators has been an important improvement and has done much to bring about better millwork. There are now several types of these accumulators being made, and either type is readily adaptable to existing equipment. They are extremely flexible and permit changes in the hydraulic loading at will. They re-act instantly when the top roll commences to raise, and exert a practically constant pre-determined pressure at all times. The old style weight loaded accumulators which were in use before the development of the air loaded accumulators, and are still in use in many factories are far more sluggish in their reaction due to the inertia of the weights, and are in addition far more difficult to adjust, or alter, for desired changes in top roll pressures.

Available information indicates that practically all of the mills in Louisiana are operating their crushers under higher hydraulic pressures and their mills under lower pressure than usually recommended and used for units of similar size and capacity. Crushers should be operated under pressure of 30 to 40 tons per lineal foot of roll length; mills seven feet long, should be loaded from 70 to 80 tons per foot; five and six foot mills should have pressures of 60 to 70 tons; and four foot mills approximately 50 tons per foot. These are recommended pressures which can be varied to suit individual conditions, but which should result in good mill work provided the top rolls are free to float and the hydraulics are in good working order.

The removal of trash and dirt from the juice pans beneath the mills, in most cases, requires considerable labor. This labor could be eliminated by using juice pans having steep sloping sides, but these pans have the disadvantage of being very deep, making it necessary to place the juice strainer far below the level of the mill floor and not many mills are situated so that this can be done. The result is that most of them have to be content with shallow pans which afford poor means of removing the trash. As

most of them are of concrete, this condition is aggravated as the concrete tends to roughen, due to the chemical action of the juice.

The substitution of steel plate pans for the concrete ones now used would be of much help in obtaining proper drainage, but because of the shallow depth of most pans, this alone would not be sufficient to insure the removal of the trash, and other means must be employed for this purpose. To accomplish this, one operator, this year, is installing steel pans equipped with drag conveyors, similar to those used in Ewart type intermediate carriers. This arrangement should be very satisfactory and should eliminate the labor at this station, although some difficulty may be experienced in the maintenance of the equipment. A simpler and cheaper arrangement would be the installation of spray or sluice pipes at the sides of the juice pans arranged so that the sprays would keep the pans clean by flushing them with juice. This juice could be taken from the juice tank under the juice strainer by means of the raw juice pump if of sufficient capacity, or by means of another pump or preferably a steam siphon installed for that purpose.

The higher speeds and grinding rates have naturally imposed increased loads and strains on existing equipment and have brought a demand for improved gearing. In most cases this improvement has been accomplished by replacing the old cast tooth gears with gears having machine cut teeth and by substituting cast steel bedplates and larger pillow blocks, for the old cast iron equipment. Mills which have not already converted their old gearing, but which anticipate increasing their speed and capacity, should be all means consider the adoption of cut tooth gears, at least for the intermediate, if not for all gears. Experience has proven their superiority under intensive operation, and their freedom from vibration at high speeds.

The development and installation of the turbine drive for sugar mills which was for so many years considered an impossibility, has opened another phase in the development of the sugar industry. It forms an economical means of replacing old, worn out engines, or engines having sufficient power and from the results shown by the initial installation, it is reasonable to assume that this type of drive will be universally adopted, especially for new installations.

The development of mechanical harvesting, which in itself has been largely responsible for the survival of the industry, has brought with it many problems seriously affecting the processor. These problems have been discussed on previous occasions, but since there exists a doubt as to whether their magnitude and importance and effect on the economy of the industry are understood by all, it might be well to consider them further.

Greatest and most important of these problems are those of trash and old cane, and their influence on capacity, maintenance, clarification, recovery, and over-all economy. Their effect on capacity and economy probably can best be illustrated by assuming, for the sake of example, a mill having a daily grinding capacity of 1000 tons of 14% fiber cane, containing 20% trash. This would then result in 200 tons of trash having approximately 90% fiber, and 800 tons of cane having 14% fiber, or 180 tons dry fiber in the trash and 112 tons dry fiber in the cane, making a total of 292 tons dry fiber to be handled by the mill, instead of 140 tons as would be the case if no trash were present.

Noel Deerr has previously demonstrated that fiber is practically incompressable beyond a certain point, and consequently is the determining factor for milling capacity (this was recently discussed by Mr. Thos. Lowe in his paper presented to the American Society of Sugar Technologists on May 22, 1946). Thus the 292 tons of fiber which has to be handled by the mill instead of 140 tons, as would be the case if no trash were present in the cane, is equivalent to 2086 tons of cane at 14% fiber. In other words the mill, while grinding only 1000 tons of cane per day, is actually grinding the fiber equivalent of 2086 tons of clean cane containing 14% fiber.

The 180 tons of dry fiber in the trash contains no sucrose as it enters the mill but absorbs sucrose during the milling process, so that when it leaves the mill as bagasse, it contains the same amount of sucrose as the bagasse. Considering 3% as an average for the amount of sucrose in the bagasse, the 180 tons of fiber absorb 5.4 tons of 10,800 pounds of sucrose which, at market value of four cents per pound, amounts to $432.00 per day or $30.240 for a seventy day crop, which is burned under the boilers or sold as bagasse.

In the past few years there was developed a rather widespread practice of cutting the cane far in advance of its delivery to the mill, the result being that mills are called upon to

grind cane which has been cut from ten days to three weeks, and which is on the point of inversion when received. This practice together with the practice of high topping and the consequent low purities results in poor clarification and poor recovery and is of such far reaching significance that it vitally affects the economic survival of the industry.

It is not within the scope of this paper to fully discuss these problems and their solution, which to say the least, is extremely difficult. They are here mentioned because of their profound effect on the industry. They are of sufficient magnitude, in the writers opinion, to command the attention of the grower as well as the processor, in an effort to produce satisfactory results.

POTENTIAL BYPRODUCTS OF RAW CANE SUGAR MANUFACTURE[1]

by L. F. Martin, Head Agricultural Chemical Research Division[2]

Presented at the Annual Meeting of the American Society of Sugar Cane Technologists, Houma, Louisiana, February 17, 1950

When I received Mr. Littell's invitation to discuss the subject of byproducts of raw cane sugar manufacture I hesitated for some time before accepting, and I approach the subject with a becoming and justifiable feeling of awe and trepidation.. This is a subject upon which so much has already been written and said, that I wondered if it would be possible to add anything that could be new or significant. There has been, in fact, not only a great deal said about the byproducts of cane sugar manufacture but a great deal has been done about them, as attested by the industrial developments based upon the utilization of sugar cane bagasse. Long before the term chemurgy was coined, the established manufacture of insulating board from bagasse by the Celotex Company was an outstanding chemurgic development. Prior even to this, the commercial manufacture of sugarcane wax had been demonstrated to be economically feasible under conditions where competition with carnauba and other natural waxes at abnormally low prices did not have to be met. Later came the manufacture of moulding plastics from bagasse by the Valite Corporation, to which my good friend the late Director of the Southern Regional Research Laboratory, Mr. D. F. J. Lynch, made no small contribution through his efforts at the Agricultural Residues Laboratory at Ames, Iowa, based on his previous experimentation on the recovery of alpha cellulose from bagasse in Hawaii. Bagasse, like

1/ Agricultural Chemical Research Division Contribution No.

2/ Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

cottonseed, oat hulls, and some other agricultural residues, has the advantage of being collected at central points incidental to the utilization of the crop from which it is produced, and it is not surprising that it should have received attention and been put early to various industrial uses. Besides all that has been written of these byproducts, countless papers have appeared perennially pointing out the potentialities of cane sugar as a source of still other byproducts.

Having accepted the invitation to speak I feel that it is incumbent upon me to survey once more the byproduct potentialities of sugar cane with consideration primarily for the crop as produced and manufactured into sugar in Louisiana. From this viewpoint it is evident that the subject has by no means been exhausted. Particularly when the mangitude of the quantities of material involved are considered, the need for many more varied and extensive byproduct developments is apparent. To see the picture clearly as a whole it is necessary to consider the composition of the more than five million tons of cane brought annually to the mills for processing, and this is possible with the aid of the recapitulation of final reports prepared by Mr. Grayson of Production and Marketing Administration as published in the special issue of the Sugar Bulletin of August 15, 1949. The latest figures available are from reports for the 1948 crop as processed by 59 Louisiana sugar mills. The data for that season is considered in arriving at the figures shown in Table 1. Any byproducts must necessarily be constituents of the cane delivered to the mills, or products produced by their chemical conversion. The table shows the amounts of all of these constituents which it is possible to calculate or to estimate from the factory operating data, other than the average of 1447 pounds of water in each ton of cane.

Table 1. Average Composition of Materials Obtained in Processing a Ton of Sugar Cane in 1948 Crop. (Based on Recapitulation of Final Reports)

Cane	1 Ton				
Fiber	299 lbs.	- Bagasse	648 lbs.	-(Fiber	299 lbs.
				(Non-sucrose	10
				(Sucrose	19.9
Sucrose	191 lbs.	- (Raw sugar	146.2	Sucrose	140.3
Less un-deter.	5.4	(Press cake	91.3	Sucrose	3.8
	185.6	(Molasses	84.0	-(Sucrose	21.7
				(Invert	20.0
Non-sucrose	83 lbs.	(		(Non-sugar	23.5
		(		(Acon. Acid	2.0
		Press cake		- Wax	0.8
				- Minor const.	0.5

In the 1948 season each ton of cane yielded, on the average, 146.2 pounds of 96° raw sugar as the manufactured product of the crop, containing 140.3 pounds of sucrose, the balance being moisture and non-sucrose dry matter of essentially the same composition as the molasses. Byproducts must necessarily come from the remainder of the constituents of this cane, of which the largest quantity by far was the fiber, amounting to 299 pounds per ton. It is of interest to note that almost 20 pounds of sucrose remained in this bagasse and was lost except insofar as it contributed to the fermentation necessary to curing of the bagasse fiber which was utilized industrially. This was only slightly less sucrose than the 21.7 pounds which remained in the final molasses. In addition it can be estimated that the molasses contained an approximately equal amount of invert sugars, and a total of 25.5 pounds of non-sugar solids of which 2 pounds can be estimated as the approximate amount of aconitic acid present on the basis of recent work on this byproduct.

There is no data in the recapitulation of factory reports or in other sources which can be used to calculate the

composition of the non-sugar solids which accumulate largely in the molasses. The figure of 23-1/2 pounds is probably too high because it was arrived at on the basis of the reported volume of 7.15 gallons of final molasses produced per ton of cane, assuming that this was calculated to 80° Brix. On a true solids basis this figure might be considerably reduced but the sucrose figure and the estimated amount of invert would also be altered. From actual average figures on the composition of the bagasse there is almost exactly 10 pounds of non-sucrose solids to be accounted for which must consist largely of invert and soluble ash constituents. Considering the assumptions which were necessarily made in regard to the estimated amounts of some of the minor non-sugar constituents the total of 65.5 pounds per ton of non-sucrose compares favorably with the 63 pounds estimated from the purity of the normal juice.

In considering potential byproduct values available in the non-sugar constituents, other than the aconitic acid and wax which are already being recovered to some extent commercially, it can safely be stated in general that they consist principally of potash which is being applied for its fertilizer value, and of the amino acid aspartic which might be recovered if uses are developed for it. In published data on the composition of cane and molasses the total amides and amino acids are calculated in terms of asparagin and aspartic acid so that definite figures on the amount of this particular acid present are not available. There are also present in the molasses organic sugar acids and minor amounts of organic decomposition products which are formed as a result of processing and are not present naturally in the cane itself.

Accepting the estimates in Table 1 as the best available for the average composition of sugarcane and its products during the season before last we can readily compute the figures shown in Table 2.

Table 2. Total Quantities of Materials Produced from 1948 Crop

Cane - 5,257,000 tons

Products:

Raw Sugar (96°)	768,000,000 lbs.	Sucrose	738,000,000 lbs.
Molasses	440,000,000 lbs.	(Sucrose	114,000,000 lbs.
		(Invert	105,000,000 "
		(Non-sug.	123,000,000 "
		(Acon. Acid	10,500,000 "
Bagasse	3,400,000,000 lbs.-	(Fiber	1,570,000,000 "
		(Sucrose	104,000,000 "
		(Non-Sucrose sol.	5,250,000 "
Press cake	480,000,000 lbs. -	(Sucrose	20,000,000 "
		(Wax	4,200,000 "
		(Other - sterols, fatty acids, etc.	2,500,000 "
Sucrose Undetermined	28,800,000 lbs.		

This table presents the total quantities of the various principal constituents which can be accounted for as they occurred in the sugar, bagasse, filter press cake, and molasses obtained by the processing of the 5-1/4 million tons of cane produced in the 1948 season. Aside from the 738 million pounds of sucrose contained in the 384 thousand tons of raw sugar manufactured, the amounts shown of the various materials present represent the total potential by-products of the industry. The most impressive quantity is the more than 1-1/2 billion pounds of bagasse fiber but is

has already been pointed out that large industrial developments in the manufacture of insulating board and moulding plastic based on this substance are well established. Research on this fiber as an agricultural residue is a function of the Northern Regional Research Laboratory of our Bureau, and it may only be noted in passing that the existing industrial uses of bagasse do not consume the entire amount available so that there is need for the development of additional uses for this fiber.

It will also be noted that the sucrose contained in the bagasse and fiber press cake together with sucrose unaccounted for reaches the impressive total of almost 153 million pounds. The unaccounted sucrose can hardly be considered available for utilization, but that in the bagasse and filter cake is undoubtedly accompanied by quantities of invert sugar which cannot be estimated from available data, and it is regrettable that there does not appear to be any feasible way of putting this otherwise lost sugar to some use. There is in fact more sucrose in the bagasse and filter cake than is available in the molosses for use in feeds and fermentation processes in which the latter material is now applied.

Taken together the sucrose and invert sugar contained in the molasses total 219 million pounds and are the second most impressive quantity of material available for the manufacture of byproducts. This large quantity of sugars does of course find an outlet principally in feedstuffs and to a lesser extent in alcohol production and edible syrups, but we are only too well aware of the price at which these markets are reached in competition with other feeds and with synthetic alcohol. The problem of turning this sugar to other and more profitable uses merits intensive study and investigation experimentally; it is not a simple one either technically or economically because of the large volume which must be utilized if the industry is to realize a substantial benefit. It is now receiving attention in the renewed investigation of the use of Louisiana blackstrap in other fermentation processes such as the manufacture of citric and lactic acids. It would require a number of such applications at increased yield and higher efficiencies of production to utilize substantially all of this sugar and justify a price for blackstrap which would be profitable to the sugar industry. To illustrate this point it has been reported that the total domestic consumption of lactic acid amounts to 8 million

pounds, which could be produced by existing fermentation processes from approximately 4% of the sugar in the blackstrap produced annually in Louisiana. Even if all of the citric acid currently used, estimated at 26 million pounds, were to be produced preferably from Louisiana blackstrap the demand could be met by less than 25% of the total molasses sugar content. There would obviously be plenty of molasses left over for the production of a variety of other products, and the need for research to further such applications along many and varied lines is evident. Another factor on the bright side of the picture is the possibility that research may effect economies in production and higher yields, thus reducing the price at which such products can be sold so that their applications and consumption could be substantially increased. Intensive research along these lines certainly holds forth great promise of eventually bringing large returns to the Louisiana Industry from the utilization of its byproducts.

It has been pointed out repeatedly that the sugars contained in blackstrap molasses constitute an extremely cheap raw material costing approximately 1 cent per pound. This is unfortunate since it means simply that molasses is selling at 6 cents or less per gallon, which price is hardly attractive to the industry producing the molasses. If the sugars could be employed for making a variety of sueful chemicals the molasses would find an outlet at a price providing profit for the sugar industry while the cost of its sugar content would still be attractive to users of this valuable raw material. An almost unlimited number of compounds are theoretically possible from sucrose or invert sugars as starting material, but unfortunately none of them other than industrial alcohol produced by fermentation are used in volumes comparable even to the production of blackstrap in Louisiana alone. A few other established fermentation products are used in fairly substantial quantities but as previously noted these quantities correspond to but a fraction of the Louisiana molasses production, and there is a choice of competitive raw materials containing sugars for manufacture of these products. It is certain that no one chemical product produced from sugars will solve the molasses utilization problem completely, but intensive research and development of new end uses for those chemicals which might be produced from molasses sugars should open up some of the potentialities of this byproduct of cane sugar manufacture. With almost 130 million pounds of sugars available in molasses it does not appear to be

sound economics to invert the sucrose of raw or refined sugar for use as a chemical raw material costing several times as much, if means of using the molasses sugars can be contrived.

Proceeding to some of the minor constituents it will be seen that the quantities potentially available are still quite large. In the 1948 crop there was available an estimated total of about 4 million pounds of recoverable refined sugar cane wax. Along with this wax were very substantial amounts of fatty acids, higher alcohols, sterols, and similar substances for which uses might conceivably be found at prices attractive to both producer and user. Since the commercial recovery of sugar cane wax has been reestablished in Cuba it remains to be seen whether the market can be maintained and expanded sufficiently to warrant domestic production of this byproduct.

Because of our activities during the past several years in developing the process used for recovery of aconitic acid, it is of particular interest to note that the 1948 crop contained, as a conservative estimate, over 10 million pounds of this byproduct. The future of this development now depends upon expansion of the end uses of this acid such as itaconic, which can be made from it. Improvements must be made in both the recovery and refining process so that the price of refined aconitic acid can be profitably reduced to a point in line with a wider range of applications. Production of acid or of equivalent aconitate during 1948 was of the order of 600 thousand pounds, which is little more than 5 percent of the total amount of aconitic acid actually available in the crop. The simple process now in operation is not capable of recovering more than half of the acid in molasses of sufficiently high acid content to be handled by it. Intensive research is in progress on various methods of separating the acid which might make it possible to recover substantially all of it. The outcome of these experiments will determine which if any of these methods will effect the recovery and purification of the acid at a cost which will permit its market price to be such that the total amount potentially available can be consumed.

A variety of organic compounds are present in much smaller amounts than those already considered and further work will be necessary before it is possible to estimate the quantities available with any accuracy. Mention has already been made of aspartic acid, which is the principal one of several amino acids in sugar cane. Inositol, which has some

use in limited quantities as an antioxidant, is known to be present in the juice and to be carried into the molasses. If the principal constituents of the filter press cake and molasses are recovered commercially, or converted chemically on a commercial scale, it is to be expected that many of these minor chemical constituents will be incidentally concentrated and that, in time, uses will be found for some of them. An example of this is the fraction removed in refining crude sugar cane wax which contains a variety of compounds, and since the material is collected incidental to the wax refining operation, these compounds are conveniently and probably cheaply available for any use to which they may be put.

In summary it may be said that the byproduct possibilities of the cane sugar industry here have by no means been overlooked, and that there are very impressive industrial developments in operation today based upon utilization of the bagasse fiber and constituents of the molasses, such as aconitic acid. Many more possibilities remain to be explored, and the field is still a fertile one in which additional important developments may confidently be expected in the future.

WASHING OF SUGARCANE IN PREPARATION FOR MILLING

by M. V. Yarbrough, General Manager Young's Industries
Youngsville, La.

Presented at the Annual Meeting of the American Society of Sugar Cane Technologists, Houma, La., February 17, 1950

Cane was washed on the main conductor at many Louisiana factories when the production of consumption sugars and molasses was the order of the day. Today, in considering the practice of cane washing at that time, four important facts must be borne in mind:

1. All cane was hand cut, hand loaded and well stripped by hand - not burned.

2. Such trash-free and char-free stalks, "clean" by today's standards, were not knifed in the conductor before crushing or milling.

3. Grinding rates of the mills were generally so small that, as compared to current conditions, the layer of stalks in the conductor was relatively thin and/or conductor speeds were relatively slow.

4. The fact that many operators of that time did wash cane indicates that some benefit must have been attributed to the washing of a cane supply already so "clean" as compared to today's deliveries to a Louisiana factory.

The production of higher fibre and harder canes, when the easily milled native canes failed in the fields, necessitated the knifing of the cane before crushing. The installation of revolving knives in and near the base of the main conductor eliminated the possibility of continuing to wash the cane on the inclined portion of the conductors. Thus, for many years after the installation of revolving knives, the practice

of washing cane was completely discontinued in Louisiana. During this interval no NECESSITY for washing cane was apparent. The cane was still hand cut and either loaded by hand or with the earlier grab type loaders after piling by hand, nor was the cane yet burned in the fields to remove the leaves. If any real benefit had been obtained from washing of cane on the conductor prior to the installation of revolving knives, that potential benefit still existed during this interval, but knifing of the harder canes was a NECESSITY and washing was not.

Then the development of the cane harvester, the increasing shortage and cost of field labor due to the war, resulting in a rapid increase in the proportion of mechanically harvested cane received at Louisiana factories, combined to place the washing of cane before milling into the category of a NECESSITY, particularly when fields are muddy. As a result cane is again being washed before knifing in many Louisiana factories.

Due to limitations of space in the various factory years, variations as to methods of cane handling at the various factory yards, variations in the degree of the necessity, if any, for washing the cane, and many other governing factors, we find many different systems of washing in use today. However these various systems generally all have two things in common:

1. Their development was borne of urgent necessity to make capacity operation possible--not primarily to improve operating results by increasing sugar yields and/or reducing operating costs.

2. Results obtained justify their existence and use.

This brief resume of the history of cane washing in Louisiana gives rise to fundamental questions:

1. If cane washing were justified prior to the necessity for use of revolving knives in our conductors, bearing in mind the inherent and apparent "cleanliness" of such cane, would the practice have continued profitable during the period when washing was universally suspended--even though capacity operation was possible?

2. Even though capacity operation is currently possible, washing as we do in various factories to make it so, how can it be determined to what extent better washing, or washing of a larger proportion of our factory supplies, would be economically justified and at what cost therefor?

If the first question could be answered definitely, the answer would be of assistance in formulating the answer to the second question which is the only one currently of importance. Since such is not the case, however, we must look elsewhere for information from which to attempt to formulate our answer to the second question. The remainder of this paper is devoted to a discussion of the second question.

"IS BETTER WASHING AND/OR WASHING OF A LARGER PROPORTION OF THE CANE GROUND BY LOUISIANA FACTORIES TODAY ECONOMICALLY JUSTIFIABLE AND IF SO AT WHAT COSTS?"

There is to this question no single answer inflexibly applicable to all factories. The proper decision for each factory must be based on the consideration of many factors and will invariably be a compromise. We will discuss some of these factors based on our experience in washing cane the past two years at Youngsville.

1. At the outset, attention is invited to the relative importance of any increase in sugar yield in Louisiana factories. One extra pound of sugar per ton of cane would increase the Industry-wide income in Louisiana nearly twice as much percentagewise as it would in the case of Cuba, our main foreign competitor in our American market. The same extra pound of sugar per ton of cane would increase the Processor's income in Louisiana approximately three times as much percentagewise as it would in the case of Processor in Cuba.

2. Data regarding the results of cane washing and capable of precise numerical evaluation is confined largely to three items of information:

   a. Sucrose content, percentagewise only and not quantitatively, of bagasse.

   b. Sucrose content, percentagewise only and not quantitatively, of filter mud.

   c. Wear on mill rolls.

3. Such data, collected at Youngsville Factory during the last three seasons, is set forth in the attached tabulation.

To facilitate the evaluation of this data, a brief resume of facts pertinent to the cane supply and washing equipment at Youngsville factory will be helpful. About 45% of the total cane ground each day during the past four years has been mechanically loaded and burned, 75% of this 45% from our own fields, loaded with self-piling loaders. The other 55% of the cane ground each day is hand cut, hand cleaned, and hand loaded. With a derrick on each side of the main cane conductor, in order to grind burned cane promptly, all such cane is unloaded and stacked by one derrick each day and completely ground out each night. The hand loaded unburned cane is unloaded by the other derrick, ground all day and a small amount stacked for reserve.

By 1947 it had become entirely clear that we must do something to reduce the earth content of our mechanically loaded cane before milling. Annual mill roll wear had reached serious proportions. Mill slippage was so great as to be evident when grinding mechanically loaded cane at night, especially in muddy weather. Night grinding rates were seriously below daytime rates. Factory crews changed at noon and midnight, each crew grinding hand loaded and mechanically loaded cane about half the time, eliminating the human element as contributory. In clarification, the same cycle was completed each 24 hours. At 6:00 P.M. when we started grinding mechanically loaded cane, mud levels in the clarifier would be so low as to permit operation of only 1/2 of our Oliver. By 6:00 A.M. mud levels would be up into lower trays of clarifier with clear juice outlets from such trays closed, and with both sides of Oliver operating full speed by 8:00 or 9:00 P.M. each night. Then at 5:00 or 6:00 o'clock in the morning with all mechanically loaded cane ground, we would start grinding hand loaded cane. Clarifier mud levels would start dropping. By 3:00 or 4:00 o'clock in the afternoon mud levels would be so low and mud so thin that 1/2 of the Oliver would have to be stopped. Then at 6:00 P.M. the cycle would start all over again. While never forced to ditch mud, it was too close for comfort every 24 hours and another hundred tons of mechanically loaded cane would have done the trick any day.

With ample yard room available and most of the necessary material on hand, in the summer of 1948 we designed and built a cane wash plant on one side of our yard to handle all mechanically loaded, burned cane. With no space limitation and little limitation because of cash outlay on account of materials on hand, we built equipment which we felt would give us as near a perfect washing job as possible. The benefits derived have far exceeded our expectations. The removal of earth and char is so complete that by appearance of bagasse at fourth mill discharge it is impossible to be certain whether unburned or burned cane is being ground. Earth is washed from masses of cane and weed roots where harvester blades have gone too deep. Drainage after washing is such that there is no drip at or after the revolving knives. Appearances indicate that we produce less Oliver mud from washed mechanically loaded cane than from hand loaded unwashed cane. How much less, if any, cannot be determined because of the use of a continuous settler. But the extent of sugar removal from Oliver muds from washed and unwashed cane is determinable.

Enthusiastic as I am over the results obtained from washing at Youngsville, I would not recommend that such washing would be universally as beneficial to all factories. We had a certain problem to solve. The necessity for washing might not be as great at other factories, costs of installation because of yard layout might be much higher, to mention but two of the many variables which would require consideration.

However, based on our results at Youngsville, I can and do recommend that the general subject of washing of cane before milling is worthy of very careful consideration by every factory operator in Louisiana. How thoroughly it would be profitable to wash the cane, and what proportion of the total supply it would be profitable to wash are questions the proper answers to which can be determined correctly only by the operators of the various factories.

At Youngsville, I am giving careful consideration to the eventual installation of the same highly efficient wash equipment for washing even our hand loaded unburned cane. I have about reached the conclusion that even such apparently "clean" can can be very profitably washed. On many occasions we have put such cane through our wash plant and the amount of dirt removed and evident in the wash water is amazing. Attempts to accurately sub-sample and analyze the wash water run off and calculate suspended solids removed from the cane have resulted thus far, I fear, in failure. Results on hand

loaded unburned cane range from 0.5% to 4% indicated earth on such cane. I find the figures difficult to believe because of the range. Another year it is hoped a rearrangement of route of wash water from wash equipment to primary sediment sump will enable us to collect more representative samples of the wash water runoff.

However, the quantity of earth visible in wash water when washing hand loaded unburned cane did cause me to attempt some calculations, the results of which are startling. Based on perfectly clean cane stalks averaging 7/8 inch diameter, of average specific gravity, there are nearly 2000 square feet of stalk surface per ton of cane. A "layer" of dry earth, or dust, only 0.0015 inch thick on the stalks would represent 1% of the weight of the cane. Add the extra surface and dust-collecting power of 2% or 3% leaves, largely sheaths, contained in this type of cane, and possibly the earth content may be higher than we have formerly thought likely. When standing by a feeder table in dry weather we all instinctively turn our heads to avoid the shower of dust that rises when a bundle of cane is dropped from the feeder table into the cane conductor.

In resume of the subject of washing cane before milling in Louisiana today, I offer the following as my present opinions on the subject:

1. The subject merits careful study and consideration by any factory grinding cane of which one-half, or more, is loaded by machine, regardless of the type of cane loaders used or the method of piling the cane in the field for the loaders, and whether or not it has ever been necessary to reduce factory operating capacity or ditch juice muds because of field mud and/or char in the cane supply.

2. Distinction must be made between clarification and filtration difficulties due to excessive quantities of mud arising from the grinding of stale and/or high-topped cane and excessive quantities of nonsettling mud caused by earth and/or char which is susceptible of removal by washing the cane.

3. Cane cannot generally be properly washed ahead of the knives in the main cane conductor. Not only will much of the total dirt remain in the cane but, based on my experience, losses of sugar in run-off of liquid contained at and behind the knives is too great to be tolerable.

4. The degree of washing efficiency justified to be sought for depends entirely on local factory operating conditions and relative cost to provide wash equipment of varying degrees of efficiency.

5. Very worthwhile washing can be accomplished on some conventional feeder tables. Possible modifications in some tables can greatly improve the efficiency of washing thereon.

6. Utmost perfection in washing demands installation of wash plant feeder tables capable of:

   a. Producing a continuous mat of some controllable thickness and with interstices between adjacent stalks to promote good drainage.

   b. Permitting wash water to be sprayed on the entire surface of each stalk while stalks are rolling and falling into the mat. The rolling and falling of the stalks assists in loosening the mud for removing by the water.

   c. Re-compacting the loose mat of washed cane, simultaneously reducing the volume before discharge into the main conductor in order to retain normal operaing speed of the main conductor and to "squeeze" the surplus wash water from the mat of washed cane so that drainage will be complete before discharge into the main conductor. Drips and attendant sugar losses at and behind the knives are thus eliminated.

7. Effective washing with drainage completed before the cane is discharged onto the main cane conductor increases the life of the costly main conductor roller chain as compared to conveying "dirty" cane on the main conductor.

8. The water required for effective cane washing can be as little as 10 gallons per ton of cane at 30 pounds pressure with proper mat preparation.

9. Disposal of wash water and earth washed from the cane will probably in most instances be found simpler and less costly than anticipated.

10. The freer the cane from leaves the more rapidly it responds to washing and the less important is the precision of mat preparation.

11. Mill roll slippage and high sucrose extraction are never concurrent during any interval of time, short or long. Presence of mud in the mat of bagasse promotes slippage of both top and bottom rolls against the mat. Slippage between bagasse particles in the mat is desired and is created in the milling process. The resulting friction between bagasse particles breaks juice cells--"grinds" the bagasse; pressure imposed by the mills expresses the juice thus liberated. The fine clay and silt fractions of soil present in bagasse are always on the surface of the bagasse particles--wet, they are "slick", reducing the desired friction between particles of fibre. Those of us who have tried the settler--mud-back-to-mill-processes know what sufficient "lubricating" of bagasse will do to both sucrose extraction and mill roll shells in short order.

12. The preparation of a "fluffy" mat of cane as for perfect washing may, under certain conditions of knifing, in itself greatly improve mill work as it did at Youngsville during 1948, and indicated positively what had been wrong with our knifing job for many years.

13. Removal of mud by washing cane will not necessarily of itself improve extraction, but it will beyond any doubt render improved extraction possible.

14. In all except the most efficient preheated air furnaces even slightly increased amounts of earth in bagasse will severely cripple furnace performance and steaming rates of the boilers from bagasse.

15. While I doubt that the extra filter mud produced by virtue of earth content of juice carries out of process its pro-rata share of the sucrose lost in filter mud, our experience indicates most clearly and decisively that presence of earth in filter mud does render the filter mud less susceptible to washing free of sugar. The less earth in the juice muds, the more readily and completely they wash free of sugar.

16. While at Youngsville we collect fine bagacillo for our Oliver filter mainly from our vibrating cold juice screens, allowing enormous quantities of bagacillo to go as far as the vibrating screens by using 1/8" diameter holes in the mill juice strainer plates at the mills, this is not generally the practice. Most factories collect fine bagacillo for their filters from screens in the bagasse conductors. We all know that just when field mud content of juice calls for more bagacillo from the bagasse carrier screens, just then less bagacillo comes through those screens for two reasons. The field mud in bagasse has, not only, by its effect on milling, reduced the bagacillo content of the bagasse, but the sticky damp field mud will also have either partly or completely gummed over the bagacillo screens in the bagasse carriers. Thus cane washing provides double insurance of ample bagacillo for Oliver filter operation. It reduces the quantity of bagacillo required and maintains an ample supply continuously.

17. Even though clarification is apparently good, if finely divided earth (all of it top soil rich in more or less readily soluble plant food minerals) be heated in the acid factory juice, in Louisiana usually at not more than 6.6pH as an end point and starting at about 5.2pH, and held at or above boiling temperature for 3 to 4 hours in the clarifier, it is inevitable that much mineral matter from the soil will be dissolved in the juice. How much the ash content of the juices and syrups may be increased thereby depends solely on the minerals present in the soil, the fineness of division of the soil particles, the acidity of the juice, the temperature of the juice and the time under heat in the clarifier. We all know that any such increase in ash will increase the QUANTITY of blackstrap necessarily to be produced. It is quite probable and in fact to be expected, that the nature of some of the minerals thus dissolved from the soil will also reduce the extent of exhaustion of sugar, resulting in the production not only of increased quantities of blackstrap but also in a HIGHER SUGAR CONTENT IN THE INCREASED QUANTITY.

The nature of this subject has made it necessary for me to present relatively few facts, many opinions, and for reasons

I have tried to outline, no definite conclusion which could apply generally to all factories. I regret that as yet so few facts capable of measurement and numerical expression are available on this subject, possibly of importance in its bearing on sugar yields in our Industry.

DATA PERTINENT TO CANE WASHING AT YOUNGSVILLE FACTORY

NOTE: During the past three crops approximately 45% of the cane ground each day was burned and mechanically loaded, remainder hand cut and hand loaded, not burned

I. Crop Average Figures

	1947	1948	1949
Tons cane ground per hour	42.31	46.02	53.45
Normal juice:-App. sucrose	13.13	11.93	12.76
-App. purity	79.67	76.28	78.86
Bagasse:-% Pol	3.55	3.40	3.22
% Moisture	50.67	48.08	47.74
Oliver Mud - % Pol.	1.70	2.16	2.25

Note: No cane washed in 1947. All mechanically loaded burned cane washed in 1948 AFTER Nov. 15th. All mechanically loaded burned cane washed throughout 1949.

II. Data Secured During 1948 Crop

	Period #1	Period #2
Tons cane ground per hour	44.40	46.46
Normal juice:- App. sucrose	12.08	12.16
- App. purity	74.29	76.79
Bagasse:- % Pol.	3.38	3.41
- % Moisture	49.04	47.91
Oliver Mud - % Pol.	2.66	1.94

Note: During Period #1, prior to November 15 no cane washed. Period #2, after November 15 all mechanically loaded burned cane washed.

III. Data Secured During 1948 and 1949 Crops

Comparison of results obtained from grinding unwashed, hand loaded, unburned cane each day from 6:00 A.M. to 6:00 P.M. and results from grinding washed, machine loaded, burned cane each night from 6:00 P.M. to 6:00 A.M.

	1948 Crop after Nov. 15		Whole 1949 Crop	
	6:00 A.M. to 6:00 P.M.	6:00 P.M. to 6:00 A.M.	6:00 A.M. to 6:00 P.M.	6:00 P. M. to 6:00 A. M.
Bagasse:				
-% Pol.	3.51	3.32	3.21	3.23
-% Moisture	48.05	47.70	47.80	47.70
Oliver Mud:				
-% Pol.	2.32	1.60	2.49	1.91

IV. Mill Roll Diameter Reduction in Inches Each Crop Expressed in Sixteenths of an Inch

	1947	1948	1949
Total tons cane ground	40,000	64,000	72,000
First mill	9	4	3
Second mill	9	4	4
Third mill	6	7	5
Fourth mill	11	8	5

Note: All rolls in each mill each year trued up to smallest diameter of any roll in the mill before re-grooving The above figures are thus actual maximum wear on rolls in a given mill due to grinding cane.

TOP ROLL ACTION IN THREE ROLLER CANE MILLS

by John H. Fitzhugh

This paper was presented at the June 1950 meeting of the Society and subsequently at the 1950 Congress of the International Society of Sugar Cane Technologists at Brisbane, Australia. The full length paper appears in the Proceedings, 7th Congress, International Society of Sugar Cane Technologists. A summary of the report follows:

A study of top roll action in the several mills of a tandem was made at various mills in Cuba. This study was facilitated by the use of a motion recorder designed for this purpose. Illustrations of typical motion charts appear in the article and furnish a basis for the discussion and conclusions. In part findings are supplemented by observations of various Louisiana mills.

CONCLUSIONS

1. The operation of many tandems can be significantly improved through devoting more attention to making the top rolls float freely and float in a level position. By studying the action of the individual mills and the factors influencing roll movement as discussed in this paper, steps can be taken to obtain the best operation possible from the tandem.

2. The use of mechanical roll movement indicators and recorders are of primary importance in determining the operating characteristics of each mill. After a mill has been made to operate with a free floating level roll, the motion recorder has proven to be of valuable service in presenting a detailed picture of the mill operations when the engineer is off duty. It has demonstrated that the operators will pay more attention to the milling operations when they know the management has a complete picture of the millwork 24 hours each day.

3. Individual mills must be maintained in good physical condition for proper grinding. The condition of crown wheels, brasses, housings, etc. are of primary importance

in achieving the best milling efficiency.

4. When a mill is in good physical condition, separate pressure hydraulic systems on each ram can maintain a free floating level roll.

5. A freely floating level roll will give better milling efficiency and better milling action than a cocked roll.

6. Very few top rolls can be maintained in a truly level position with a single pressure hydraulic system.

7. In Louisiana, approximately 10% of the sucrose in cane is lost in the milling operation and yet many factories pay little attention to obtaining the best possible results on their equipment. Even very old mills will perform with relatively good extraction efficiency if they are kept in good physical condition and receive proper attention during grinding.

A STUDY OF THE FACTORS AFFECTING GROWERS' JUICE SAMPLES

by W. M. Grayson, Production & Marketing Administration, U. S. Department of Agriculture

Presented at the Meeting of the Manufacturing Section of the American Society of Sugar Cane Technologists, Houma, Louisiana, February 17, 1950

Most of you are familiar with the provision of the Fair Price Determination of 1949 and previous determinations that fix the price to be paid by processors who are also producers for sugarcane purchased from other producers. For the benefit of those who are not directly engaged in the production of sugarcane for sugar I wish to briefly outline some of the provisions of the Determination.

Fair Price Determinations have been issued for each crop since the 1937 Sugar Act was enacted, and through the 1948 crop each of these determinations have approved the basic pricing structure agreed upon by producers and processors. Fair Price Determinations generally have contained the following provisions:

1. The basic price for standard sugarcane was $1.00 per ton for each one cent of the average price of 96 degree sugar when such price was 3-1/2 cents per pound with a maximum of $1.03 per one cent of the price at and above 3-3/4 cents per pound and adjustments downward to a minimum price of 91 cents per each 1 cent of price at or below 2-3/4 cents per pound.

2. Settlements were based on the weekly average of the daily prices of 96 degree raw sugar (duty paid basis, delivered), or the seasons' average ot the weekly quotations.

3. Standard sugarcane was defined as sugarcane containing a stated range of sucrose in normal juice with premiums or discounts for sugarcane of higher or lower sucrose content.

4. During the crops 1943 through 1947 weight deductions of trash in excess of 3% were permitted by administrative action, and in 1948 the definition of standard cane was revised to provide weight deductions for trash in excess of 3%.

5. Since the 1940 crop, each price determination has provided for payments to producers equal to 50 percent of the proceeds from blackstrap molasses in excess of 8 cents per gallon.

6. Under certain conditions deductions were permitted in the price paid for frozen sugarcane.

The 1949 Fair Price Determination differed from the 1948 Determination in the following major respects:

1. The basic price was increased from $1.03 for each one cent of the average price of raw sugar to $1.045.

2. The definition of standard sugarcane was revised to mean trash-free sugarcane with a normal juice sucrose content of 12.0% and a purity of at least 76.5 but not more than 76.99 in the place of a stated range or normal juice sucrose alone. Premiums and discounts above and below 12.0 were provided, as in the past, as were also premiums and discounts for purities above and below normal ranges.

3. The definition of salvage sugarcane was revised to include sugarcane with normal juice having less than 9.5% sucrose or purity less than 68.0, and the price for such cane was that agreed upon between the producer and processor.

4. Trash was defined to include green or dry leaves which may be removed with a cane knife in a manner similar to hand stripping under field conditions, loose sugarcane tops, attached sugarcane tops at or above the green leaf roll, dirt and all other extraneous material. The 3% trash tolerance was eliminated from the determination.

5. The molasses payment provision was revised to permit participation by producers above 6 cents per gallon instead of 8 cents per gallon as in previous determinations

6. Mills located in high cost freight districts were permitted to make reductions from the average price of raw sugar for the higher cost of shipping raw sugar to New Orleans from such districts.

7. Deductions permitted because of acidity of frozen sugarcane were revised to make allowance for the changes in the normal acidity of the varieties currently being grown and harvested.

8. Sucrose and purity tests were to be made on the basis of trash-free cane and in an acceptable manner.

9. Allowances made to producers for transporting sugarcane from the customary delivery point to the mill were to be continued, but not in excess of the actual cost or rates charged by a commercial carrier for the customary method of transportation.

10. Authority was provided for the sharing of the actual cost of field inspection of trash determinations under certain conditions.

In general, the chief objectives of the 1949 Determination was to provide a mechanism through which producers would be paid a price based on the quality of sugarcane delivered. To accomplish this basic pricing factor for fresh clean sugarcane of standard quality was increased to $1.045, premiums were provided for sugarcane of higher than standard quality and discounts provided for sugarcane of lower than standard quality. By so doing it was hoped that improvement in the quality of the sugarcane delivered would provide higher profits to producers and that settlements would more accurately reflect the milling value of sugarcane.

As pointed out above, for many years settlement for sugarcane in Louisiana has been on the basis of the percentage of sucrose in normal juice, and during the 1949 crop on both normal juice sucrose and purity of trash-free sugarcane. Also, since conditional payments under the provisions of the Sugar Act of 1948 are made on the basis of normal juice sucrose on

trash-free sugarcane, it is most important that sampling of producers' sugarcane be adequate and that all sucrose and purity tests be accurately made. The factors that affect the final results are many and varied and should be thoroughly understood by producer and processor.

Most everybody connected with the Louisiana sugar industry understands that normal juice brix and sucrose are derived figures. They are not obtained by direct analysis but by the application of certain well understood factors. If the factors are correctly obtained and the analyses of the juices from the sample mill are correctly carried out, there is little possibility of error in the final result. On the other hand, unless careful attention is given to all details in connection with tests of sugarcane deliveries, there is possibility of injustices being done.

Normal juice (Cane Sugar Handbook, Spencer-Meade, Seventh Edition) is defined as "the juice extracted by dry milling, i.e., milling without saturation of the bagasse." Since this is rarely if ever, carried out in actual practice, the calculation of normal juice is made from the density of the crusher juice and the purity of the mixed or diluted juice. A factor is calculated from the density of the crusher juice and that of the mixed juice obtained in dry milling when no maceration water is used. This factor is applied to the brix of the crusher juice to ascertain the brix of the normal juice. Example:

Crusher juice brix	16.50
Mixed juice brix	16.0

$$\frac{16.0}{16.5} = 0.97 \text{ dry milling factor}$$

The brix of the normal juice multiplied by the purity of the mixed juice gives the sucrose of the normal juice. The dry milling factor is used every day during the crop or until a change is suggested by circumstances, and it is the basis for all calculations of the daily factory average normal juice brix and sucrose.

When sugarcane is washed before milling, and on rainy days, the crusher juice is diluted and, therefore, the density is not truly representative. Under these conditions, the brix of the crusher juice must also be calculated. This is done by making comparative analyses of sample mill juice and crusher juice on dry cane. A run should be made over not

less than a six-hour period, preferably twelve hours, at the beginning of the crop under normal milling conditions and the factor computed from the result. Continuous sampling of the crusher juice and sample mill juice from the same sugarcane being ground of the big mill should provide a proper basis for comparison. Once established, the daily average brix of all sample mill tests divided by the factor will give the true brix of the crusher juice for the day when cane is washed. This corrected crusher juice brix multiplied by the dry milling factor will give the brix of the normal juice.

The daily factory average normal juice brix and sucrose is the basis for all calculations of normal juice brix and sucrose of producers sugarcane deliveries, and unless this has been properly determined and this normal juice is derived from the same sugarcane tested on the sample mill (or crusher) for the account of the producer during the same twelve or twenty-four hour period, the brix and sucrose factors derived therefrom will not be truly applicable.

Now, a work about brix and sucrose factors to be applied to producer's tests in order to arrive at normal juice brix, sucrose and purity. If the test is made on the crusher juice sample, the problem is comparatively simple, provided the cane is dry, that is, not washed or rained on. The factors for converting crusher juice to normal juice are obtained from the previous day's daily factory averages. For example,

Crusher juice	Brix 16.40	Suc. 12.80	Purity 78.05
Normal juice	Brix 15.91	Suc. 12.22	Purity 76.81

Brix factor $\frac{15.91}{16.40}$: .97

Sucrose factor $\frac{12.22}{12.30}$: .9547

When a sample mill is used for testing producers' sugarcane, the problem is not quite so simple since the sampling procedure is more complicated. Fundamentally, the principle is the same. The simple or weighted average of all tests made on the sample mill in any given period is compared with the normal juice brix and sucrose of the factory averages during the same period. Example:

Normal juice (factory average)	brix 15.91	suc. 12.22	purity 76.81
Sample mill juice	brix 16.70	suc. 13.72	purity 82.16

Brix factor $\frac{15.91}{16.70} = .9527$

Sucrose factor $\frac{12.22}{13.72} = .8907$

The above factors obtained for the preceding twenty-four hour period are applied by all individual tests on the sample mills the succeeding day. The simple average may be used when there are a large number of tests made during the day or when each test represents a proportionate part of the total cane delivered. When there are only a comparatively few shippers, it is better to use the weighted average of tests arriving at the factors, otherwise the tests of large shippers may have too great an influence on the tests of small ones.

A summary of all tests cf producers' sugarcane made by mills during the 1949 crop has recently been compiled in the State Office of the Production and Marketing Administration for the purpose of ascertaining the degree of accuracy of the system used in arriving at the fair normal juice sucrose and purity of individual growers. These reports of thousands of tests were broken down into the same groups as those used in the recapitulation of final manufacturing reports. The simple average of all tests by mills is compared with the weighted average obtained from the final factory run reports in Table I below.

Table I

	Crusher Juice		Normal Juice	
Group I & II	Brix	Sucrose	Brix	Sucrose
Simple average	16.76	13.13	16.28	12.44
Weighted average	16.37	12.72	15.85	12.11
Group III				
Simple average	16.75	13.23	16.25	12.49
Weighted average	16.70	13.14	16.22	12.54
Group IV				
Simple average	16.95	13.19	16.50	12.60
Weighted average	16.78	13.00	16.34	12.49
Group V				
Simple average	16.66	12.99	16.24	12.35
Weighted average	16.66	12.98	16.19	12.37
State Average				
Simple average	16.66	13.02	16.21	12.36
Weighted average	16.66	12.98	16.19	12.37

In the above table it is seen that there is very close agreement between normal juice brix and sucrose arrived at by the methods used by the mills in sampling and testing growers' sugarcane. Group I and II were further apart than any of the others, but this group was composed of only five small mills and the discrepancy favored the producers in every instance. The State average was almost identical with that shown on the recapitulation which speaks well for the system.

Since brix factors and sucrose factors were computed in exactly the same manner and there would be no particular advantage in discussing both, for the sake of simplicity, sucrose factors only will be considered at this time. Also, since the conversion of crusher juice sucrose to normal juice sucrose offers no particular problem, except in a general way where cane is washed (which has already been discussed), comment will be limited to sample mill tests and the factors that affect growers' juice samples.

Table II

Mill No.	Comparative Values of Individual Mills: Crusher Juice Sucrose	Normal Juice Sucrose	Sample Mill Sucrose	Sucrose Factors
1	13.45	12.68	15.82	80.15
2	12.38	11.62	13.91	83.53
3	12.96	12.21	14.61	83.57
4	12.96	12.20	14.55	83.94
5	12.71	11.92	14.20	83.95
6	12.92	12.30	14.63	84.06
7	12.80	12.07	14.34	84.22
8	12.99	12.24	14.50	84.38
9	12.86	12.07	14.30	84.41
10	12.73 12.88	12.11 12.14	14.34 14.52	84.47 83.67
11	13.10	12.20	14.42	84.64
12	13.10	12.42	14.61	85.01
13	13.53	12.89	15.13	85.13
14	13.40	12.56	14.74	85.32
15	12.75	12.09	14.12	85.61
16	12.82	12.25	14.31	85.62
17	13.19	12.49	14.55	85.84
18	13.39	12.74	14.84	85.91
19	13.02	12.34	14.34	86.05
20	12.76 13.11	12.00 12.40	13.95 14.50	86.08 85.52
21	13.10	12.42	14.42	86.18
22	12.51	11.84	13.72	86.28
23	13.47	12.88	14.89	86.50
24	13.71	12.81	14.74	86.86
25	13.11	12.33	14.19	86.89
26	13.14	12.27	14.12	86.90
27	13.53	12.59	14.43	87.28
28	13.75	13.03	14.93	87.31
29	12.33	11.75	13.43	87.46
30	13.29 13.19	12.66 12.46	14.45 14.33	87.62 86.93
31	13.08	12.48	14.23	87.68
32	13.25	12.53	14.29	87.72
33	13.13	12.84	14.56	88.18
34	13.12	12.53	14.16	88.41
35	13.03	12.41	14.03	88.51
36	13.57	12.76	14.42	88.53
37	13.25	12.69	14.33	88.59
38	12.79	12.25	13.85	88.65
39	14.08	13.35	15.04	88.76
40	13.25 13.26	12.43 12.63	13.98 14.29	88.90 88.39

Table II (continued)

Mill No.	Comparative Values of Individual Mills: Crusher Juice Sucrose	Normal Juice Sucrose	Sample Mill Sucrose	Sucrose Factors
41	12.50	11.91	13.37	89.06
42	13.12	12.38	13.83	89.49
43	13.83	13.09	14.63	89.50
44	13.19	12.68	14.14	89.62
45	13.06	12.55	13.94	90.06
46	13.64	13.10	14.44	90.72
47	13.27 13.23	12.60 12.62	13.81 14.02	91.26 89.96
Total	13.13	12.44	14.35	86.70
State Aver- age	12.98	12.37	14.27	86.71

Table II shows comparative values of crusher juice sucrose, normal juice sucrose, and sample mill juice sucrose, and the conversion factors for the same, of the forty-seven mills using sample mill tests for determining normal juice sucrose from individual producers' sugarcane. The factors have been arranged in the order of their numerical value from lowest to highest and are divided into series of ten (seven in the last group) to compare the relationship between the factors, sample mill tests, and normal juice sucrose. It is coincidental that the crusher juice sucrose increases from 12.88 to 13.26%. The normal juice sucrose likewise increases as would be expected. From this one might think that the sample mill sucrose content would also increase. This is not the case, although the factor does increase to maintain the relationship. If the factor were constant, then the sample mill test would have to show a higher sucrose content. However, since this is not so, some sample mills must be more efficient then others or the quantity of cane per sample ground is not sufficient to give good extraction. A study of the sample mills in use in 1949 bears out this fact. In those factories where the sample mill was equipped to put pressure on the top roll, where the grooving was in good shape, where sufficient power was provided to mill a sizeable sample and a fair

quantity of cane was milled at one time, the factors were higher and more uniform from day to day.

A further study of the factors computed from daily averages of a sample of ten mills selected at random shows considerable variation from day to day and from week to week. The latter is less pronounced but considerable nevertheless. The study covers a period of six weeks beginning when the crop was well started and ending six weeks later before any of the mills in the group closed down.

Table III (on the following page) shows a comparison of the weekly average of each of the ten mills mentioned above and the weekly variation of each mill from November 5, 1949, to December 10, 1949, inclusive. Weekly factors varied from a minimum of 2.02% to a maximum of 6.03%, with the average 3.70%. Factors were generally low at the start before the cane reached maturity, but were fairly stable after three weeks. However, it is quite apparent that improvement can be shown if better control of sampling, milling, and testing is adhered to.

The following factors have a decided influence on the determination of normal juice sucrose and purity of individual growers' samples:

1. Determination of the daily factory average crusher juice and normal juice brix and sucrose. Since these are basic, unless the sampling, preservation and testing of these juices are carefully and properly done, the factors which are related to them cannot be correct.

2. Efficiency of the sample mill equipment.

3. Proper sampling of sugarcane.

4. Correlation of cane sampled to cane ground on factory mill.

5. Proper taking and preservation of sample mill juice.

6. Proper analysis of sample mill juice.

7. Washing cane and rainy weather.

TABLE III

COMPARISON OF SUCROSE FACTORS

Week Ending	Mill No.	1	2	3	4	5
Nov. 5	Sucrose Factor	85.99	88.61	82.88	88.47	85.03
Nov. 12	"	87.71	89.39	82.91	89.95	87.89
Nov. 19	"	88.32	89.27	85.56	90.86	88.24
Nov. 26	"	90.34	90.63	81.18	89.25	89.20
Dec. 3	"	89.63	89.71	90.48	90.99	87.42
Dec. 10	"	88.47	88.84	86.16	91.34	90.55
Six Weeks Average	"	88.41	89.41	83.53	90.06	88.65
Maximum Variation	"	2.42	2.02	4.98	2.86	5.96

OF TEN LOUISIANA MILLS

6	7	8	9	10	Weekly Average of 10 Mills
87.36	89.71	87.41	82.78	81.38	85.96
87.61	88.18	86.24	85.59	79.93	86.54
89.26	87.59	87.87	86.32	78.80	87.21
86.93	87.36	88.02	88.81	81.04	87.28
87.42	84.97	87.62	86.44	80.59	87.03
86.20	86.04	88.56	85.53	79.17	87.09
87.46	87.31	87.62	85.91	80.15	86.85
3.06	4.74	2.32	6.03	2.58	3.70

8. Delivery time factor.

9. Quality and age of administration sugarcane.

10. Quality and age of cane piled for night or week-end grinding.

It is the opinion of the writer that much improvement can be made in the use of sample mills to determine normal juice sucrose and purity of growers' sugarcane and the following suggestions are made as a uniform procedure.

1. A good sample mill should be employed, one equipped with hydraulics and sufficiently powered to give good extraction.

2. Samples of sugarcane should fairly represent the total deliveries of each grower every day. There should be one sample for each ten or fifteen tons of cane ground and where the delivery is less than this amount the sample should be taken of the delivery.

3. Where samples are composited in racks, not less than five stalks should be pulled from each bundle. When samples of cane are ground immediately, not less than ten stalks should constitute a sample.

4. Samples of crusher juice and mixed juice should be taken continuously and tested at least every three hours. Composite samples may deteriorate in warm weather if kept longer even with proper preservatives.

5. Since growers' cane is generally sampled and tested during the day, factors should be established on a twelve-hour basis, that is, on the cane ground during the same period.

6. Sugarcane ground on the big mill during periods when no deliveries are being made should not be used in factoring. This includes piled cane and cane stored in cars for overnight or over week-end grinding.

7. When sugarcane is washed or wetted by rain the crusher juice analyses should be adjusted to a dry cane basis.

8. Growers' sample cane should also be dried with a towel or air dried before grinding on the sample mill.

9. Factors should be calculated daily, but it would appear better to use weekly average factors rather than daily ones.

10. Every effort consistent with good practice and economy should be exercised in arriving at a fair and equitable test of all samples, grower and processor.

The writer believes that the results of the past crop fairly represents average conditions, but since an average is a mean proportion, there must be tests below the average as well as test above; therefore, procedures should be adopted that will make the variation so small as to be valueless.

Discussion of this vital subject is invited.

PROCEEDINGS

American Society of Sugar Cane Technologists

1950-1953

January, 1955

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Volume 4

January, 1955

FOREWORD

This is the fourth volume of proceedings of the Society which have been published since its founding in 1938.

The first volume published in 1941 included papers presented during 1938, 1939 and 1940. Mr. Walter Godchaux, Jr. the then-Secretary-Treasurer edited that volume.

The second volume published in 1946 included papers presented during the period 1941-1945 inclusive. Dr. E. V. Abbott, Secretary-Treasurer, edited that edition.

The third volume published in 1953 included papers presented during 1946-1950 inclusive and was edited by the writer. This the fourth volume includes papers presented in 1951, 1952 and 1953. It is contemplated that publication in the future will be on at least a bi-annual basis.

ARTHUR G. KELLER

SECRETARY-TREASURER

January 1955

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Agricultural Section

Manufacturing Section

SOIL PRODUCTIVITY UNDER A NON-LEGUME (SUGAR CANE-CORN) ROTATION SYSTEM

by E. C. Simon, Agronomist, Louisiana Sugar Experiment Station

Presented to the Agricultural Section of the American Society of Sugar Cane Technologists, Houma, Louisiana, July 10, 1951

The Mississippi river alluvial soils of the South Louisiana sugar district, where much of the sugar cane of this area is grown, are possessed of great inherent fertility. The climatic conditions are such, however, that these soils, when kept under cultivation, rapidly lose soil organic matter and humus, and consequently nitrogen, and so decrease in productivity.

Under the standard rotation system where usually three crops of sugar cane are rotated with the summer legume soybeans, and where practical a winter legume crop is planted on the fall plant cane, the soil productivity level is maintained at a reasonably satisfactory level for the plant cane crop. Response to additional commercial nitrogen fertilization is dependent on the over all soil productivity level, varieties grown, and methods of soil management.

Regardless of the previous summer, or summer and winter legume treatments in the rotation cycle, fertilization with commercial nitrogen is necessary for the production of maximum crops of stubble cane.

Nitrogen is as far as we know the main fertilizer element limiting the production of sugar cane on these Mississippi river alluvial soils. A marked response to phosphoric acid and potash has not been consistently received.

This paper gives data from the long term soil depletion plot experiment on the Louisiana Sugar Experiment Station where no summer or winter legumes are grown in a rotation of sugar cane with corn.

We believe that the yields per acre in the plant cane year (which are dependent entirely on the soil productivity level as no nitrogen or other fertilizers are applied to this crop) are a good yardstick to measure the soil productivity level under this rotation system.

Plot History

In the fall of 1929 a plot of ground was planted in block plantings of several varieties of sugar cane. This plot was one of the most fertile on the Sugar Station. For many years prior to 1923 it had been in sod; from 1923 through 1927 corn and soybeans had been planted on it, the corn stalks and soybeans being turned under; in 1928 and 1929 soybeans alone had been planted and turned under. We then had as our starting point a plot of ground which should be of high productivity (previous experiments and experience indicated that a high degree of fertility should be present in the soil; it had been under sod for many years and heavy crops of legumes had been turned under.)

Procedure Followed

1. Drainage was kept in good condition at all times.

2. No summer or winter legumes were turned under after the 1929 crop.

3. The plant cane crop has never received fertilization of any kind.

4. The corn crop has never received fertilization of any kind.

5. Each stubble cane crop has received a standard application of 36 pounds of mineral nitrogen per acre.

6. No organic matter has been added except that present in the sugar cane trash (after burning), sugar cane roots, corn stalks and roots, and the small amount of spring, summer, and winter weed growth.

Yields and Comparative Sucrose Analyses. (Composite samples milled on Sugar Station Mill. Extraction approximately 60%.)

		Plant Cane					First Year Stubble Cane					Second Year Stubble Cane				Third-Year Stubble Cane	Fourth Year Stubble Cane
	Cycle	Brix	Apparent Sucrose	Purity	Tons Acre		Brix	Apparent Sucrose	Purity	Tons Acres		Brix	Apparent Sucrose	Purity	Tons Acre	Tons Acre 1933	Tons Acre 1934
									Co. 290**								
12/13/30	I*	12.80	7.37	57.57	45.58	12/12/31	14.00	9.21	65.78	52.45	10/28/32	15.40	11.20	72.73	38.99	38.59	33.69
11/25/36	II	16.00	11.81	73.81	38.41	10/29/37	15.20	11.36	74.74	31.58	11/4/38	16.70	13.10	78.44	30.86		
11/15/40	III	18.50	14.74	79.68	26.72	11/12/41	16.50	13.76	83.39	34.01	10/22/42	14.45	10.66	73.77	27.88		
									C. P. 29-116								
11/3/44	IV	15.20	12.42	81.71	24.36	11/10/45	15.90	12.47	78.43	24.61	10/15/46	15.20	11.76	77.37	17.64		
11/30/48	V	16.70	13.35	79.94	28.71	10/29/49	14.90	11.20	75.17	29.95	10/16/50	17.40	13.34	76.67	14.92		
									Co. 281								
	I	13.70	8.85	64.59	36.41		15.80	11.56	73.16	31.25		16.70	13.79	82.57	29.04	26.43	21.74
	II	15.80	12.07	76.39	31.73		14.80	11.32	76.49	22.94		16.40	12.89	78.60	24.21		
	III	18.60	15.19	81.67	19.57		16.90	13.76	81.42	26.28		14.85	11.63	78.32	21.53		
	IV	15.30	12.08	78.95	14.37		15.70	12.99	82.74	16.08		15.20	12.50	82.24	12.78		
	V	16.00	14.08	88.00	23.67		14.10	11.12	78.87	18.19		16.40	13.03	79.45	5.41		
			C. P. 807***					C. P. 29-320***									
					37.38					34.70					25.41	23.05	19.20
	I		C. P. 29-320														
	II	16.90	13.04	77.16	32.56		16.30	13.06	80.12	27.15		18.30	14.94	81.64	28.97		
	III	20.70	17.43	84.20	21.38		19.20	16.38	85.31	27.01		16.25	12.76	78.52	25.05		
	IV	16.70	13.81	82.69	18.59		16.70	13.76	82.40	19.89		16.10	13.42	83.35	15.61		
	V	17.00	14.88	87.53	23.34		15.80	13.22	83.67	21.31		19.00	15.55	81.84	10.38		
								C. P. 34-120****									
	I																
	II																
	III																
	IV	16.00	12.54	78.38	24.36		16.50	13.49	81.76	25.34		15.70	13.06	83.18	16.63		
	V	16.40	13.99	85.30	26.54		14.80	11.59	78.31	22.51		17.90	14.96	83.57	11.83		
								C. P. 36-105****									
	I																
	II																
	III																
	IV	17.00	13.68	80.47	23.12		17.20	14.19	82.50	24.79		16.40	13.85	84.45	17.24		
	V	17.50	14.90	85.14	27.77		16.60	13.29	80.06	25.81		18.40	14.55	79.07	10.93		

* Plant cane yields in Cycle I were calculated from "seed cane" yields, allowing 20 per cent for green tops and trash.
** In Cycle IV - Co. 290 was replaced with C. P. 29-116.
*** In Cycle II - C. P. 807 was replaced with C. P. 29-320.
**** C. P. 34-120 and C. P. 36-105 added in 1943.

Discussion of Results to Date

Considering the data presented in the table as well as data and observations on our other experimental plots which are not included in this paper, the following summary of the performance of the plot is made:

Cycle I (1929-35) The initial fertility of the soil was so high that heavy tonnages of low sucrose plant cane were produced. In the stubbles to which 36 pounds of nitrogen per acre were applied, the yields appeared to be in the order of the stubbling qualities and vigor of the individual varieties; sucrose analyses of the stubble crops were relatively low when compared with the regular Sugar Station soil fertility and variety plots. The soil productivity level is indicated by the yields of fourth year stubbles, Co. 290 yielding 33.69 tons per acre, Co. 281, 21.74 and C.P. 807, 19.20.

In contrast, plant cane yields of C.P.29-116, Co. 281 and C.P. 29-320 in the Fifth Cycle (1948-50) were 28.71 tons per acre, 23.67 and 23.34 tons respectively.

Cycle II (1935-39) The level of soil productivity was still high and we were able to obtain good yields of plant cane and satisfactory yields of first and second year stubbles. The sucrose content of all varieties was satisfactory and was about normal for the sucrose analyses of the same varieties on the regular Sugar Station plots.

At this stage the plot was in the condition of reasonably productive sugar cane soil, and appeared to have lost a great deal of its original ligh level of fertility.

A standard rotation system of three years of sugar cane with one crop of corn was established in this cycle.

Cycle III (1939-43) A very noticeable drop in soil productivity occurred, as measured by the yields of plant cane. The first and second year stubbles produced fairly satisfactory yields when fertilized with 36 pounds of nitrogen per acre.

The plant cane of this cycle was characterized by its extremely high sucrose content and comparatively low per acre yield.

Cycle IV (1943-47) C.P. 29-116 replaced Co.290 in this cycle. The level of soil productivity was able to produce 24.36 tons of plant cane of the variety which is one of our heaviest yielders. Co281 yielded 14.37, and C.P. 29-320, 19.81 tons per acre respectively.

Cycle V (1948-50) The soil productivity level appears to have stabilized. Plant cane yields were as high in this cycle as in the two previous cycles.

Conclusions

This soil depletion plot, begun in the fall of 1929, and now in its twenty-second year, which has had a minimum of organic matter added to its soil, no summer or winter legumes, and only 36 pounds of inorganic nitrogen on each of the stubble cane crops, shows the effect of poor soil management practices on an extremely fertile soil. We find that the original high level of soil productivity of this Mississippi river alluvial soil has been greatly reduced. The soil, however, still possesses a fairly good productive capacity as judged by the yields of the plant cane crops.

CONTROL OF JOHNSON GRASS ON CINCLARE PROPERTIES

By R. T. Gibbens, Jr., Field Manager, Cinclare, La.

The four plantations under the supervision of the Cinclare Central Factory include approximately 4,000 acres of cultivable land. Of these 4,000 acres, approximately 2,200 acres are in sugarcane each year. About half of this acreage is in plant cane and the other half is in first stubble. No second stubble is being raised because Johnson grass infestations have made second stubble yields uneconomic. Of the remaining 1,800 acres, 1000 or more acres must be fallow plowed thoroughly each year to destroy the Johnson grass plants which have come in from seedlings in the plant cane and 1st. stubble crops. Of the four plantations, three have been very heavily infested with Johnson grass and seed populations in the soil are very high. (75,000 to 300,000 per acre 2-1/2" of soil after fallow plowing.) The other plantation (Choctaw) while not free of this pest has not had the large populations of viable seed in the soil as did the other three plantations and the fallow plow program has been sufficient to permit economic stubble crops.

Losses from Johnson Grass

In order to arrive at an estimate of the losses due to Johnson grass, the yields of the four plantations were summarized from plant and first stubble crops for three years. These data are shown in Table 1. It may be seen that while plant cane yields were similar, stubble yields dropped from 43 to 50 percent on the plantations where Johnson grass reinfestations were heavy and only 23 percent on Choctaw where infestations were lighter.

In addition to the above, yields of plant cane and 1st stubble were obtained from similar plots of several acres except that in 1948 and 1949 the reinfestation by Johnson grass was kept out in one plot by hand roguing the usual field cultivations practiced in the other. Both had been fallow plowed before planting. The yields, shown in Table 2,

indicated a decrease in stubble yields similar to those in Table 1 and an additional 10 percent loss in plant cane.

When the information in the two tables are analyzed, it is found that a measurable difference in yield of approximately 2.4 tons in plant cane per acre and 4.5 tons per acre in 1st stubble are attributable to Johnson grass, This when translated into the economics of production is equal to 7,000 tons of sugarcane per year, or over $50,000.00 annually which has been lost to Cinclare Factory Plantations. In addition, another $16,000.00 is spent annually for labor and fuel in plowing the lands the 8 to 10 times necessary to destroy Johnson grass before planting. Since no 2nd stubble crops can be raised because of Johnson grass reinfestations, two-thirds of the plantations are devoted to sugarcane, rather than close to the ideal three-fourths possible if no Johnson grass were present.

Control Practices

In the fall of 1947, the first large scale use of chemicals for controlling Johnson grass reinfestations was made. Sixty acres of plant cane were sprayed in the fall of 1947 with 2,4-D as a pre-emergence application. In the spring of 1948, these sixty acres of plant cane were sprayed twice with 2,4-D before layby and once after layby. While control of reinfestation was far from complete, the 1st stubble crop showed a definite improvement on Johnson grass control. Labor costs were lower and there were increased yields in these sixty acres over the plantation average.

On the basis of this preliminary test, and observations of Experiment Station plots, 600 acres of plant cane were sprayed with 2,4-D as a pre-emergence spray in the fall of 1948. In the spring of 1949, 800 acres were first hoed and them sprayed with 2,4-D and flamed. The usual tractor cultivation was practiced and after layby a blanket spray of 2,4-D was applied. The above practices were continued in 1950, and in 1952, TCA ≠ 2,4-D was submitted for the 2,4-D plus flame cultivation in the plant cane, and TCA was used in the stubble crops both in 1951 and 1952.

In order to arrive at some measure of the yields obtained as a result of the program, yields before and after chemicals were used are shown in Table 3. Yields of plant cane and succeeding stubble crops indicate an increase in yields as a result of the improved Johnson grass control, since the three plantations with Johnson grass were lower

in yields than Choctaw before chemical control was used, and were above Choctaw after chemical control was started. Johnson grass on Choctaw plantation has increased the last two years until it has been necessary to institute a chemical control program.

Table 4 gives the total labor costs for the four years 1947-1950. It may be seen that labor costs dropped in 1949 on the three plantations where chemicals were used in 1949, and that costs dropped in 1950 on the fourth plantation when chemicals were used.

Discussion

While Cinclare properties still have too much Johnson grass, there is little doubt that progress has been made in reducing this pest. As seeding populations have been lowered from the chemical control program for a cane cycle, efficiency of the herbicides has increased, since seedlings appearing are fewer. Costs for labor have been reduced from $15.04 per acre in 1947, to $6.05 in 1952. The 1952 cost figures include .39 per acre for labor in applying the chemicals. The cost of the chemicals, fuel and oil for application averaged $6.04 per acre, bringing total costs to that of the labor costs before chemicals were used. However, yields have increased and Johnson grass is being reduced.

Much more needs to be done before Cinclare Properties are free of Johnson grass, but results indicate that it is economically possible to approach this goal.

Table 1. Yields of sugarcane in tons per acre of plant and 1st stubble crops on Cinclare Central Factory Plantations for three years.

Plantation	Yields in tons per acre Plant cane	1st. stubble	Decrease in per cent
	Heavily infested		
Cinclare	17.34	9.68	44
St. Delphine	24.34	12.23	50
Additions	20.05	11.34	43
Average	20.58	11.08	46
	Less heavily infested		
Choctaw	20.05	15.74	24
Difference	- .12 tons	-4.66 tons	-22%

Plant cane for years 1946, 1947, 1948

1st stubble for years 1947, 1948, 1949

Table 2. Differences in yields between plot kept free of Johnson grass and plot cultivated in routine manner (C. P. 29-320 in fallow plowed land).

Treatment	Yields in tons per acre Plant Cane	1st stubble	Decrease in per cent
Johnson grass controlled	27.99	20.09	28
Field check	25.20	13.03	53
Difference in tons	-2.79	-7.06	
Difference in percent	10	-	25

Table 3. Yields of plant and 1st stubble cane on 4 plantations of Cinclare Properties.

	Yields in tons per acre of plant cane and succeeding 1st stubble crops			
	1947-48	1948-49	1949-50	1950-**
	Three plantations with much Johnson grass			
Plant cane	16.06	22.77	26.50*	19.46
1st stubble	11.52	12.98	18.18*	-
Total	27.58	35.75	44.68	19.46
	One plantation with less Johnson grass			
Plant cane	16.57	25.53	23.67	17.09*
1st stubble	18.02	14.04	16.84	-
Total	34.59	39.57	40.51	17.09
	Difference in yield			
Plant cane	- .51	-2.76	+ 2.83	+2.37
1st stubble	-6.50	-1.06	+ 1.34	-
Total	-7.01	-3.82	+ 4.17	+ 2.37

* Chemical control program used.

** Early freezes necessitated cutting back plant cane with high losses in tonnage.

Table 4. Labor costs per acre for four year period on four Plantations of Cinclare Properties

	Cost per acres in dollars			
	1947	1948	1949	1950
	Three plantations with much Johnson grass			
Plant	15.41	15.34	9.51*	9.78*
1st stubble	14.67	14.66	10.23	8.99*
Total	30.08	30.00	19.74	18.77
	One plantation with less Johnson grass			
Plant	16.18	14.94	12.19	10.07*
1st stubble	16.01	16.81	12.11	8.98*
Total	32.19	31.75	24.30	19.05
	Differences in cost per acre			
Plant	- .77	+ .40	-2.68	- .29
1st stubble	-1.34	-2.15	-1.88	+ .01
Total	-2.11	-1.75	-4.56	- .28

* Chemicals used for weed control.

WEED CONTROL IN SUGARCANE

By

E. R. Stamper and S. J. P. Chilton

The following recommendations for Johnson grass control in sugarcane are based on the results from over five years of research by the Louisiana Agricultural Experiment Station. While the recommendations are not considered to be the ideal ones, they are the best available, both from the research results obtained, and trial by various individuals on their own plantations. There is no doubt that new chemicals will eventually reduce costs considerably and also will increase the efficiency of a chemical weed control program, but no one can afford to wait until the ideal program is found.

Johnson Grass Control in Fields

Fallow Plowing: It is necessary to plow thoroughly six to eight times all land to be planted to sugarcane in order to kill the Johnson grass plants and their rhizomes from the previous stubble cane crop. There is no substitute for fallow plowing.

Plant Cane Crop: In order to prevent reinfestation of the plant cane from Johnson grass seedlings, and in most areas where large amounts of Johnson grass occur in stubble crops there are seedlings, a chemical control program is essential.

Fall Treatment: (For cane planted August 1 to October 15)[1]

1. Surface of soil should be made firm by rolling or cultipacking immediately after planting and covering the cane.

2. Apply a drill spray of 1 lb. acid equivalent of the

[1] Amounts of chemicals given are actual amounts to be used per acre.

amine salt of 2, 4-D on band 36'' wide on top of the row.

3. Approximately three weeks later, or after a rain, apply 4 to 7 lbs. of 90% TCA powder or 5 to 9 pints of liquid TCA (50% liquid concentrate) per acre on 24'' drill area, depending on the number of seedlings escaping the 2, 4-D treatment.

4. Cultivate middles and sides of rows as needed, and rogue carefully.

Spring Treatment.

1. Immediately after shaving and offbarring, if shaving is practiced, apply 4 lbs. of 90% TCA powder or 5 pints of liquid TCA (50% liquid concentrate) on 24'' to 30'' band on drill.

2. One month later or immediately after fertilizing the cane, apply same amount of TCA as given in 1, plus 1 lb. acid equivalent of amine salt of 2, 4-D on 24'' to 30'' band on drill.

3. Rogue as necessary to remove Johnson grass plants which have escaped the chemical.

4. Apply 2 lbs. acid equivalent of 2, 4-D as blanket spray (the whole area of row) immediately after lay-by.

5. A careful roguing is recommended after layby.

Stubble Cane

Recommended for badly infested stubble and for stubble from plant cane under a control program if the stubble is shaved and off-barred.

1. Shave, offbar, and if possible use a rotary hoe or stubble digger.

2. Apply 11 lbs. of 90% TCA powder or 15 pints of liquid TCA (50% liquid concentrate) on a band 24'' to 30'' wide on drill. This should be applied immediately after shaving and offbarring, and before the Johnson grass has sprouted.

3. Apply 2 lbs. acid equivalent of amine salt of 2, 4-D per acre as a blanket spray immediately after layby.

4. Knife escaped Johnson grass heads to reduce seed production.

Spot Treatment

Recommendations where only an average of one stool of Johnson grass can be seen heading every 50 ft. of row or less than one every 50 ft. of row, and seedlings are known not to be too plentiful.

1. Apply 1 lb. acid equivalent of the amine salt of 2, 4-D per acre on 24'' to 30'' band on drill, either after shaving, or if cane is not shaved, when off-barring is done.

2. Spray the Johnson grass plants when they flower and can be seen above the cane, with one of the two following solutions:

    a. 1 to 1-1/2 lbs. of sodium chlorate plus 1/2 to 3/4 lb. of calcium chloride per gallon of water.

    b. 3/4 lb. of 90% TCA powder or 1 pint of liquid TCA per gallon of water.

Either of above solutions will kill Johnson grass plants, but where there are a considerable number of Johnson grass stools per acre, the sodium chlorate is considerably cheaper. It is necessary to be sure the Johnson grass plants are covered with the spray solution.

Costs

Approximate costs per acre exclusive of fallow plowing (all steps recommended are included):

Plant Cane

Chemicals (Fall)		$ 2.30	- 3.35
(Spring)		5.50	- 5.50
	Total Chemicals	7.80	- 8.85
Spraying (5)		2.50	- 2.50
Roguing (2)		2.50	- 2.50
	Total Cost	$12.80	- 13.85

Stubble Cane

Chemicals	$5.65
Spraying (2)	1.00
	$6.65
Labor (knifing)	1.50
	$8.15

Costs estimated from following figures:

2,4-D	$3.60 a gallon (4 lbs. acid equivalent)
TCA	.35 a pound (90% T.C.A.)
Spraying	.50 per spraying per acre
Roguing	1.25 per acre

The cost of spot treatment of Johnson grass plants in stubble is difficult to estimate as the cost of the chemical used goes up rapidly as the number of plants per acre increases.

Ditchbanks and Headlands

1. Spray at rate of 600 pounds per acre of sodium chlorate plus 300 lbs. of calcium chloride in 400 gallons of water. Spray when Johnson grass is beginning to flower.

2. Spot spray with same strength solution the next two or three years those plants which were missed or escaped the first chemical treatment.

Chemical Weed Control in Sugarcane Where Johnson Grass is Not a Problem

In areas where Johnson grass seedlings are not a problem but other grasses and broadleafed weeds are a problem it is advisable for the sugarcane grower to follow the recommendations for Johnson grass seedling control in plant cane.

In areas where grass is not a problem and broadleafed weeds are the main problem, follow the same steps recommended for Johnson grass seedling control using 2, 4-D alone and leaving the TCA out of the spray solution.

Cautions and Hazards in Using the Recommended Chemical Herbicides

2, 4-D is a plant killer. Extreme care should be taken to prevent the drift of spray solutions to sensitive plants such as cotton, bell peppers, ornamental shrubs, etc. The use of 2, 4-D in areas where cotton is grown should be restricted to use in early spring, before cotton is planted or to the fall after cotton has been harvested.

Sodium chlorate is a fire hazard. Care should be taken to change clothing after applying it, and it should never be used unless calcium chloride is added as a safener. Smoking or open flames should be avoided.

T. C. A. in concentrated liquid or powder will burn the skin. Care in handling is important.

The recommendations on the manufacturer's label for handling all chemicals should be followed.

THE USE OF CMU IN THE SUGAR INDUSTRY

By

G. L. McCall

Presented at the American Society of Sugar Cane Technologists meeting at Houma, Louisiana, July 1, 1953.

During recent years, Sugar Cane Producers in the United States have been faced with a growing shortage of labor. Whole families are leaving the plantations to take jobs elsewhere and it has become difficult to secure replacements for the people who have left. At the same time, the wages paid to labor have risen steadily.

Because of these conditions, it has become imperative to increase the efficiency of the available labor while holding sugar production costs to a minimum. To meet this problem, the industry as a whole is rapidly mechanizing its field operations with complete mechanization as the ultimate goal.

The use of chemicals in weed control operations offers many advantages in the mechanization program. These advantages are reflected in increased yields, in reduced weed control costs and in decreased need for scarce hand labor.

CMU weed killer offers possibilities for use by the Sugar Industry in their weed control operations. Certain of these possibilities and suggested methods of use will be discussed here.

Sugar Refineries:

The first use for which CMU was approved and adopted on a large scale was for the control of weeds around industrial installations. These included oil refineries, pumping stations, lumber yards, pole yards, power plants, stock piles, storage yards, etc. In fact, CMU is now being used wherever vegetation can cause a fire

hazard, maintenance problem, personnel hazard, or simply where the presence of weeds is an eyesore that should be eliminated for reasons of good housekeeping.

The use of CMU to control vegetation around sugar refineries and machinery yards is no different than its use around other industrial installations--it is merely an extension of a practice which already is well established throughout industry. For elimination of all weeds from around the refinery installations, it is suggested that 80% CMU Weed Killer be used at the rate of 40-80 lbs. per acre, depending upon the problem encountered. If applied to vegetation consisting mainly of annual weeds less material generally is needed than where deep-rooted perennial weeds are encountered. In fact, in many situations of this sort, 20 lbs. per acre of 80% CMU is sufficient to do the job. It should be pointed out, however, that the residual effects of CMU in this instance ordinarily will not persist for as long a period as they do when greater quantities are applied.

It has been found that the younger a plant is, the easier it is to control with CMU. For example, germinating crabgrass seedlings can be controlled for a period of 6-8 weeks by the use of 2 lbs. 80% CMU Weed Killer per acre applied as a pre-emergence treatment. It may require 10 lbs. per acre or more to kill the plants after they have become established. Therefore, it would seem logical to apply the chemical as early in the growing season as possible.

Railroad sidings or spurs running through plantations often are infested heavily with serious weed pests. Elimination of these weeds will prevent their spread onto the cultivated fields, aid in track upkeep, reduce maintenance costs, eliminate fire hazards and give a neat appearing property. The same general procedures of treatment with CMU apply here as they do to the control of weeds around other industrial sites such as refinery areas, storage buildings, garages, laboratories, etc.

Johnson grass:

Up until the past few years, the sugar cane fields of Louisiana had become more and more heavily infested with

Johnson grass. In some areas, there was practically a solid infestation in the canefields and on headlands and ditch banks. In fact, there were areas where serious consideration was being given to converting fields from sugar production to pasture land.

However, in the middle forties, the Louisiana Experiment Station and certain of the sugar companies decided to institute a research program directed toward the use of chemicals as a supplement to cultivation methods of Johnson grass control. As a result of this program, sodium chlorate, 2,4-D and TCA (sodium trichloroacetate) have all taken their place in the program of Johnson grass control. Now CMU has entered the field of chemical weed control and it appears that it will fit well in the control program being carried on by the plantations.

Essentially, Johnson grass control in the cane fields consists of three basic steps beginning after the last crop of stubble cane has been harvested.

First, the cane field proper is fallow plowed every two weeks, weather permitting, beginning in the spring and lasting through early summer. Six plowings usually are required to destroy the established Johnson grass rhizomes. The plowings turn the rhizomes up to the soil surface where they die from exposure to the sun. This treatment is especially effective during the drier periods of the year.

Row ends are cross plowed while a special plow is used two or three times along the base of the ditch banks at each plowing of the field.

Second, the Johnson grass growing along the ditch banks and headlands where it cannot be reached by plowing may be controlled by the use of chemicals. If the grass on these areas is not controlled it serves as a continuous source of infestation for the cane fields--both from seedlings and rhizomes.

Previous results in various sections of the country have shown that from 40-80 lbs./acre of 80% CMU Weed Killer will eliminate established stands of Johnson grass from railroad rights-of-way, tank farms, storage areas and other places which ordinarily cannot be cultivated successfully. These rates of application also will prevent Johnson grass seedling re-establishment for a period of

at least one growing season.

In general, tests have shown that CMU acts primarily through the plant roots. To insure that maximum effectiveness is obtained from the material applied, care should be taken to see that it reaches the ground in which the Johnson grass is growing. This can be done by mowing and removing the plant tops from the area before treatment is applied or by waiting to treat until after the tops have been winter-killed and burning them where they stand.

If CMU is then applied evenly over the area with a relatively large volume of water (400 gallons/acre) the results obtained usually are very uniform and quite satisfactory after rainfall has had an opportunity to carry the material into the root zone of the Johnson grass. On the basis of results obtained to date, it is believed that applications made during the late winter or early spring before the Johnson grass had begun to grow are in general more satisfactory than are applications made during the summer or early fall when the soil is likely to be hot and dry.

It also has been noted that Johnson grass control in drainage ditches is most satisfactory if the treatment is applied shortly after the water has drained away, but while the ditch banks still retain some of their moisture. Where Johnson grass was treated with CMU while the ditches were full of water, control tended to be poor within 3-4'' of the water line.

Because of the excellent results obtained from its use experimentally and due to the relatively low order of toxicity that it exhibits toward warm-blooded animals, application will be made to the USDA in the near future for registration of a claim for the commercial use of Du Pont 80% CMU Weed Killer on drainage ditches.

After the fields have been fallow plowed and the headlands and ditch banks have been cleaned up the third step in the Johnson grass control program begins. This consists in preventing the re-establishment of Johnson grass by control of the seedlings in the cane field. Once these seedlings have a chance to form rhizomes, they become quite difficult to eliminate from the cane and will serve as a new source of infestation.

CMU applied as a pre-emergence treatment to sugar cane immediately following planting in the fall or

after shaving and off-barring in the early spring has been found to be a very effective treatment for prevention of Johnson grass seedling infestations.

In Hawaii, this pre-emergence type treatment of sugar cane with CMU was carried out with a great deal of success by personnel of the Hawaiian Sugar Planters Association and the Hawaiian and Commercial Sugar Co. There CMU as a pre-emergence spray has given outstanding control of annual weeds when applied at a rate of 3 lbs. active per acre immediately following the planting of the cane and its use for that purpose is rapidly increasing. This type of treatment has given 90% or better weed control for a period usually ranging from 5-21 weeks with no injury to the crop. However, application of CMU is not recommended at dosages higher than 5 lbs./acre active at one time and the total amount used on any one cane crop tentatively has been limited to 7-1/2 lbs. per acre active.

The same general type tests were carried out in Louisiana during 1951 and 1952 by the Louisiana State Experiment Station and by Du Pont representatives. In these tests, CMU was applied at rates of 1/2 to 16 pounds active per acre as a pre-emergence spray immediately after shaving and off-barring operations had been concluded in the spring.

Results indicated that 3 lbs. active CMU per acre (1 lb. active per acre applied over the row as a 2 foot band) gave consistently good control of Johnson grass and other germinating seedlings without injury to the cane. A lower rate of 2 lbs. per acre did not give good control of the Johnson grass seedlings in all tests.

In view of the good results obtained from these experiments, CMU was recommended for use in Louisiana during 1953 on a trial basis. A number of plantations have made tests with the material and according to the figures we have at our disposal, something over 200 acres of plant cane in Louisiana have been treated during the months of March and April.

These treatments were located on at least 14 different plantations with the largest test covering approximately 30 acres. Dosages used have ranged from 1 to 1.25 lbs. of 80% CMU Weed Killer per acre applied to a 2 foot strip centered on the row. This is equivalent to 3 to 3.75 lbs.

per acre of 80% CMU applied as a blanket spray.

The results obtained from those treatments in general have proved to be excellent and are about what was expected of the compound. The control of germinating weeds and grasses has been very good with no apparent damage to the cane. Johnson grass seedling control in particular has been very gratifying and most of the treated fields are practically free of this pest.

There have been a few exceptions to the good results obtained. In one case, a cooperator reported that CMU gave no better control of weeds than did the 2, 4-D + TCA combination treatment. Another report shows that the CMU treatment was unsatisfactory when applied to a field of stubble cane after a stubble digger had been run over the surface of the cane row. The material was applied over a 2-foot center at the rate of 1.16 lbs. of 80% CMU Weed Killer with the hope that it would retard development of Johnson grass rhizomes already present as well as kill the new seedlings. The rhizomes were not controlled at this rate as would be expected, and the field is infested with Johnson grass.

Still another cooperator reported that CMU did an excellent job on Johnson grass seedlings but did not control some of the common weed varieties such as blood weed, etc. In this case, trouble was encountered with the sprayer since the 100 mesh screens in the system were not replaced with 50 mesh. There is some question as to just how much CMU actually went on the field.

No doubt many of the tests will be discussed in greater detail during the course of this meeting, but it is felt in view of the excellent results obtained this spring on a majority of the plantations where it was tested, that CMU will have a definite place in the Johnson grass seedling control program. It should be applied as a pre-emergence treatment to plant cane in the spring after shaving and off-bearing at a rate of 1 to 1.25 lbs. /acre of the 80% material.

Preliminary tests at the Louisiana State Experiment Station also have shown that pre-emergence applications of CMU to the cane fields in the fall immediately after planting have given good control of weeds at 2 lbs. per acre. Therefore, present plans call for the pre-emergence treatment of a number of acres of sugar cane this fall

with CMU on a trial basis. These applications will help the growers to decide whether or not the use of CMU on cane at that time is a sound practice.

To sum up, experiments by various agencies have shown that there are a large number of situations where CMU can be used profitably as a weed killer, and it can be predicted that it will assume an increasingly important part in the chemical weed control programs of the Sugar Industry as a whole.

PRACTICAL ASPECTS OF EXTENSIVE CHEMICAL WEED CONTROL IN LOUISIANA SUGARCANE

Dennis A. Domangue, Agronomist, Godchaux Sugars, Inc.

Since 1948, the methods practiced for the control of weeds in sugarcane have undergone radical changes on the properties of Godchaux Sugars, Inc. It is probable that the 10,000 acres in cultivation have been subjected to a more intensive weed control program in the last four years than the properties of any other large sugarcane producing company in Louisiana.

These changes evolved as a result of solid infestations of Johnson grass (Sorghum halepense) in the cane fields, on the headlands, and on the ditchbanks. As the programs used to control this pest were put in practice, it was found that nearly all the other grasses and broad-leafed weeds commonly occurring in the fields were also being eliminated.

This progress was achieved by the substitution of herbicidal chemicals for the older methods of cutting and digging out Johnson grass plants, and flame cultivation.

In 1946, it was decided to initiate a research program to find chemicals which could be used on sugarcane and still control or eradicate Johnson grass present. A few acres were treated experimentally the first year, and on the basis of the very promising results obtained, larger acreages were treated in 1947 and 1948. In 1949 a complete control program with the use of chemicals was started on a field scale, together with the changes in cultural practices found to be necessary.

As a result of this program, on six of the nine plantations making up the 10,000 acres of cultivation, such progress has been made that eradication of Johnson grass is considered possible and the program is designed to obtain this objective. The fields of the other three plantations have been so thoroughly infested with Johnson grass seed that a great deal more effort is necessary until seed populations in the soil are reduced to reasonable levels.

However, such progress has been made, that the fields of these three plantations look entirely different than they did six years ago, and the goal of eventual eradication appears quite feasible. To illustrate the accomplishments in reducing Johnson grass, six years ago, it was thought that on the largest plantation (2000 acres) of the nine, sugarcane would have to be discontinued and the fields turned into pasture. Average yields had dropped to only 13 tons of sugarcane in 1947. This plantation at present is averaging 25 tons to the acre.

The program which is being used consists of a combination of fallow plowing, diligent use of chemicals, and hand-roguing of escaped plants where necessary.

The first step in the control of Johnson grass is fallow plowing after harvesting the second or third crop of sugarcane from the original planting. Weather permitting, this involves six plowings at two week intervals in the spring and early summer. The purpose of these plowings is to turn up to the surface all Johnson grass rhizomes possible so that they will be exposed to the sun, dry up and die, especially in the hot summer months. The ends of the rows are also cross plowed, and near the ditchbanks, a special plow is used two or three times at each plowing of the field. These extra plowings are made because of the greater number of rhizomes present along the ditchbanks and at the ends of the rows.

When it is found that the fallow plowing has destroyed the large Johnson grass plants and their rhizomes, the land is prepared for planting. The cane used for planting is always selected from areas free of Johnson grass in order to eliminate any possible reinfestation in planting.

After planting, the cane is covered, cultipacked, and one lb. acid equivalent of 2, 4-D (2, 4-Dichlorophenoxyacetic acid) per acre is applied on the drill area. It is important to cultipack or roll the tops of the rows as many more Johnson grass seedlings emerge from a loose and fluffy soil. This premergence spray with 2, 4-D is essential in that it will prevent a majority of Johnson grass seedlings from emerging and will also keep the drill area free of other weeds, thus promoting better germination of the sugarcane without the usual weed competition. As high as twenty percent more shoots of sugarcane have been

observed where the drill area was sprayed with 2, 4-D immediately after planting, even in land with no Johnson grass.

If, because of unfavorable weather or other factors, Johnson grass seedlings escape the 2, 4-D treatment, 4 lbs. of T.C.A. (Sodium trichloroacetate) are applied on the drill area. Seedlings appearing on the sides and middles of the rows are eliminated by the regular cultivating tools. In addition to the chemical treatments a certain amount of hand roguing is usually necessary.

Three to four weeks after the chemicals are applied, the winter cover crop (Melilotus indica) is planted. Although the chemicals are applied on the drill area and the Melilotus is planted on the sides of the row, it is still necessary to wait three to four weeks after spraying to insure good germination of this legume.

In the spring and summer, several different treatments are used, depending on the weed problems and whether the sugarcane is a plant cane or stubble crop.

The program in the plant cane in the spring is begun immediately after shaving the cane, which is usually done in February. An application of 2, 4-D at one lb. acid equivalent per acre on the drill area is made as soon after shaving as possible. This is done to control Johnson grass and other weed seedlings. Three to four weeks later, or after off-barring, where past histories of the land indicate large amounts of Johnson grass seed to be present, 6 lbs. of T.C.A. per acre are applied on a band 36'' wide on the drill area. Approximately four weeks later an application is made of 4 lbs. of T.C.A. and one lb. acid equivalent of 2, 4-D per acre on the drill. After this application and until layby, Johnson grass plants which have escaped the treatment are carefully hand-rogued. Upon receiving the last or layby cultivation, two more lbs. of 2, 4-D acid equvalent are applied per acre as a blanket spray (spray of the total area) to reduce the emergence of Johnson grass seedlings during the remainder of the growing period.

The above program has at the same time controlled the other broad-leafed weeds and grasses common to the cane fields. The layby spray of 2, 4-D is especially helpful in infestations after layby of morning glory vines (Ipomoea coccinea), cypress vine (I. quamocit), and the

tie vine (Jacquemontia tamnifolia).

Where none or very few Johnson grass seedlings are expected, the spring application of chemicals is reduced to two applications of one lb. acid equivalent of 2, 4-D per acre on the drill, one after shaving and the other after off-barring, and a blanket spray of 2 lbs. of 2, 4-D per acre after layby.

In certain areas of black (sharkey clay) and mixed soils, the two grasses, red root (Setaria sp.) and crab grass (Digitaria sp.) often appear in large numbers. In these fields, 4 lbs. of T.C.A. per acre are used as pre-emergence spray on the drill area. If a post-emergence spray becomes necessary, 4 to 6 lbs. of T.C.A. are used per acre on the drill. Both crab grass and red root must be sprayed while still small seedlings for adequate control.

The program used to reduce Johnson grass in the stubble crops is rather costly, particularly in the second stubble crop, where rhizome infestations are usually very heavy. Experience has shown it is better not to shave heavily infested stubble cane. One lb. acid equivalent of 2, 4-D applied on the drill is substituted for shaving to kill the winter broad-leaf weeds and those appearing in the early spring. As soon as the Johnson grass plants begin blooming, they are spot sprayed with a solution with one lb. of sodium chlorate and one-half lb. of calcium chloride per gallon of water. While the cane suffers a temporary stunting for about three weeks, the sodium chlorate is translocated to the rhizomes of the Johnson grass and these are eventually killed. Very diligent supervision and the best of labor are needed at this time so that careless and unnecessary spraying of the sugarcane is avoided.

Eradication of Johnson grass on the ditchbanks and headlands becomes necessary as the fields are cleaned up to prevent reinfestations. Previous methods included the use of hand labor and weed burners. Since 1949, sodium chlorate (plus calcium chloride as a safener) has been used on the ditchbanks. The amount is 1.4 lbs. of sodium chlorate plus .7 lb. of calcium chloride in one gallon of water per 100 square feet of area sprayed. It is necessary to spray when the Johnson grass is in flower. The

ditchbanks where cane is growing are sprayed first in the spring, and then the ditchbanks in land being fallow plowed to eliminate the rhizomes. In both cases, the area to be sprayed is reduced as much as possible by plowing with special ditchbank plows. This is done to use the minimum amount of chemical.

After the first spraying, the ditchbanks must be followed from year to year and those areas needing spraying attended to. Approximately one-fifth as much chemical as used the first year is needed the second year. By the third spraying almost complete eradication is obtained.

Marginal lands, other than ditchbanks are mowed because the enormous amount of sodium chlorate necessary has postponed use of chemical control in these areas. Therefore, mowing and, in some cases chopping and discing, is done to prevent the formation of seed by the Johnson grass.

In conclusion, the properties of Godchaux Sugars, Inc. have shown great response to the use of chemicals for reducing Johnson grass and other weeds. Not only has the use of chemicals enabled the reduction of a dangerous pest, thus increasing sugarcane yields per acre, but it has also eliminated hand hoeing, with much reduced labor costs. This has been necessary because of present high costs of production coupled with shortage of labor due to the war conditions. The results to date have been excellent, and it is the intention of the company to direct their agricultural research program to seek for better, safer, and cheaper chemicals.

STUDIES ON THE KEEPING QUALITY OF SUGARCANE FOLLOWING INJURY BY FREEZING TEMPERATURES DURING 1950-51

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A rather severe freeze, occurring throughout the sugar belt of Louisiana from November 25 through November 28, left most of the cane injured to the extent of killing all the eyes. Minimum temperatures during that period at the Houma Station were: November 25, 23°; November 26, 28°, November 28, 31°F. Much of the cane throughout the sugarcane area had previously been injured to the extent of killing the terminal buds and a few eyes by freezing temperature on the nights of November 5 (29°F); November 12 (33°F); and November 13 (31°F). A considerable quantity of cane remaining to be harvested was affected by these temperatures since they occurred so early in the season. Consequently, the problem of just what practices should be adopted to minimize the deterioration of freeze-injured cane came to the fore. Since the degree of injury, the quantity of standing cane, the maturity of the cane, the varieties of cane, and environmental factors prior to and following the freeze varied throughout the sugar belt, all growers were not faced with the same problem.

The effects of freezing temperatures on different varieties of sugarcane and the millability of damaged sugarcane, as well as the keeping qualities of freeze-injured cane have been

1/ Acknowledgement is made to Mr. L. G. Davidson, Associate Chemist, Division Sugar Plant Investigations, for making juice analysis, and to Mr. R. T. Balch, Senior Chemist, Agricultural Research Division, Bureau of Agricultural and Industrial Chemistry, for making acidity and pH analyses.

reported in great detail in previous publications [2/], [3/] covering the period from 1930 to 1945. However, due to the many variables involved, the freeze injury problem varies somewhat from year to year. For this reason the same type of experiment cannot be repeated every year, and each year's data must be interpreted with the prevailing conditions in mind. An accurate evaluation of the relative susceptibility of varieties of sugar cane and the subsequent keeping qualities of freeze-injured cane is difficult to attain. In an attempt to evaluate as many aspects of the problem as possible, several types of experiments were conducted at the Houma Station during the past season to study the deterioration of frozen cane.

2/ Lauritzen, J. I., Fort, C. A., and Balch, R. T. Windrowing and storing of sugarcane in Louisiana following injury by freezing temperatures. U. S. Department of Agriculture, Technical Bulletin 736. 1940.

3/ Lauritzen, J. I., Balch, R. T., Davidson, L. G., and Arceneaux, G. Effect of freezing temperatures on different varieties of sugarcane and the millability of damaged sugarcane in Louisiana. U. S. Department of Agriculture, Technical Bulletin 991. 1949.

EXPERIMENTAL DATA

Following the freezes of November 5 and November 13, cane of varieties C.P. 29/120 and C.P. 36/105, with the terminal buds killed, was windrowed and adjacent cane left standing. The data from subsequent sampling of these 2 lots of cane are shown in table 1. In this experiment standing cane did not show a purity drop until after the 16th day in the case of C.P. 36/105 and the 22nd day in the case of C.P. 29/120, in spite of the fact that there were 4 successive nights of freezing temperatures, November 25 through November 28. By the 46th day, however, the standing cane showed the effects of these subsequent freezes (December 7, 22°F; December 11, 28°F; and December 19, 31°F) and had deteriorated to the extent of a 22 point drop in purity of C.P. 29/120, and a 13 point drop in purity of C.P. 36/105, with corresponding acidity increases as indicated in the table. Although the windrowed cane of C. P. 29/120 dropped in purity more rapidly than standing cane in the first 22 days of the experiment, the protection of the windrow is evidenced by a relatively small drop in purity and little increase in acidity by the end of 46 days. Windrowed cane of C. P. 36/105 showed a 9 point drop in purity but no measurable increase in acidity during the 46-day period of the experiment.

The four successive nights of below-freezing temperatures, November 25 through November 28, damaged most of the cane to extent of killing all the eyes. Several storage experiments were conducted with cane damaged to this extent. Since there were no previous data on the keeping quality of burned frozen cane, two lots of cane of C.P. 36/105, one burned and the other unburned, were placed in the storage rooms at 55°, 65°, and 75°, at both high and low humidities. At the same time a lot of unburned cane of the variety C.P. 34/120 was placed in the storage rooms. As might be expected, the data from this study (not given in this report) showed that the burned frozen cane deteriorated much more rapidly than unburned cane, the rate of deterioration being greater in the warm moist rooms than in the cool dry rooms. In contrast with what may be expected with uninjured cane, the unburned frozen cane showed greater deterioration under moist conditions than under dry conditions at each of the three temperature levels. The opposite is true for cane that has not been injured from freezing

or burning. These comparisons in deterioration are based on purity changes and acidity increase.

In another study with cane of the variety C.P. 36/105, in which all the eyes were killed, the cane, both burned and unburned, was stored in open racks. One-half of this cane was sprinkled twice daily, the other half left unsprinkled. After fifteen days of such storage the burned, sprinkled cane showed the greatest purity drop and increase in acidity, although the acidity did not increase appreciably until after 11 days of storage. Both sprinkled and unsprinkled frozen unburned cane kept better than the unsprinkled frozen burned cane. Acidity increases were not great after fifteen days of these treatments.

Until about 10 years ago the practice of windrowing frozen cane was common in Louisiana, but under present conditions of mechanized harvesting the procedure is not considered practicable. Consequently, following the severe freezes in November, growers tried several other means of retarding deterioration of frozen cane. Some cut down a large portion of cane with mechanical harvesters, placing it in 6- to 8- row heaps; others cut the cane down in regular heap-rows; and many left the cane standing, and harvested the most severely damaged cane first. In order to evaluate the keeping qualities of sugarcane so treated, plots of twelve released varieties (Co. 281, Co. 290, C.P. 29/103, C. P. 29/116, C. P. 29/320, C. P. 34/120, C. P. 36/13, C. P. 36/105, C. P. 36/183, C. P. 43/47, C. P. 44/101, and C. P. 44/155) were (1) left standing, (2) windrowed, (3) piled in 6-to 8-row heaps, and (4) left in a normal heap. Samples were taken at various intervals from each treatment lot. The data for 5 of these varieties are shown in table 2. These varieties illustrate the two extremes in keeping quality and show in a general way the effects of the various treatments on any one variety. With all 12 of the varieties the standing cane deteriorated more rapidly, as shown by purity drop and increase in total acidity, than the windrowed cane or the cane cut and put across the rows. The standing cane of all varieties showed good keeping qualities up until the time of the second freeze on December 7. After that the standing cane showed varying degrees of deterioration depending upon the variety. Standing cane of C. P. 29/116 after 32 days showed the greatest purity drop, 17.9 and the greatest acidity increase, 2.35 cc. Standing cane of C. P. 44/101 for this same period showed the least purity drop, 3.4, and an acidity increase of .85 cc. The other varieties shown in table 2 deteriorated at rates between these extremes.

Sugarcane of all varieties when windrowed kept better than under conditions of any of the other treatments. With windrowed cane, differences in rate of deterioration between individual varieties were relatively small as indicated by drops in purity after 36 days ranging from 4.5 for C. P. 29/320 to 0.2 for Co. 281. None of the samples from windrowed cane showed excessive acidity increases.

The behavior of the cane cut and placed in heap-rows of various sizes was much more variable. Under these conditions Co. 281, Co. 290, C. P. 29/320, and C. P. 36/13 kept approximately as well as in windrow. On the other hand, C. P. 36/183, C. P. 36/105, C. P. 29/116, and C. P. 44/155 so treated showed keeping qualities more nearly as maintained in comparable plots of standing cane. The rate of deterioration in 6- to 8- row heaps as compared with that in 3- to 4- row heaps varied somewhat with different varieties, but overall results from this study indicated no significant differences between these two treatments. For the most part, the rate of deterioration of cane cut and placed across the row was between that of standing and windrowed cane, as indicated by changes in purity and acidity. But in this connection it is interesting to note that the recently released variety C. P. 44/101, cut and placed in 6- to 8- row heaps, showed essentially no loss in purity and relatively little increase in acidity between November 27 and January 2.

CONCLUSIONS

In experiments during the 1950-51 season it was found that standing cane of varieties C. P. 29/120 and C. P. 36/105, with the terminal buds killed by freezing temperatures, did not give evidence of deterioration until sixteen days later when it was more severely damaged by subsequent freezes. Windrowed cane of C. P. 29/120 showed little deterioration after 46 days whereas windrowed cane of C. P. 36/105 in the same period showed as great an amount of deterioration as standing cane of that variety.

Burned frozen cane deteriorated much more rapidly than did unburned cane, especially under warm moist conditions. Badly frozen cane which had not been burned deteriorated more rapidly under moist conditions than under dry conditions.

Tests that compared twelve commercial varieties of cane under the following conditions: (1) Standing, (2) windrowed, (3) in 6- to 8-row heap-rows, and (4) in 3- to 4-row heap rows,

showed that windrowed cane deteriorated more slowly and to a lesser degree than either standing cane or cane cut and put across rows. Within the limits of this experiment it was found that C. P. 29/116 showed poor keeping qualities as compared to the rather good keeping qualities of C. P. 44/101. This relationship may also be a result of the degree of initial injury which is impossible to measure beyond the point of killing all the eyes. On the whole, with the exception of a few varieties in this variety test, the cane showed keeping qualities better than might be expected from previous results 2/, 3/ with similar degrees of damage. This was probably due to an unusual combination of environmental and physiological conditions. The cane at the time the first freeze occurred had a very high purity. (The average apparent purity of all varieties in all tests included in this report on November 27 to December 1, was 86.0.) The night temperatures during the period that followed the freeze were relatively low. Although the rainfall was approximately normal, it was more evenly distributed during the period than might ordinarily be expected. This also played a part in retarding deterioration of frozen cane, especially in the case of cane cut and put across the rows. All of these factors were responsible for minimizing sugar losses that could have been considerable with the same degree of injury under different conditions.

TABLE I

Effect of freezing temperatures in November and December 1950, on Brix, apparent sucrose, apparent purity, and acidity in standing and windrowed cane of varieties C. P. 29/120 and C. P. 36/105.

Date of Analysis	Duration (days)	C. P. 29/120								C. P. 36/105							
		Standing				Windrowed				Standing				Windrowed			
		Brix	Sucr.	Purity	Total acidity*	Brix	Sucr.	App. Purity	Total acidity*	Brix	Sucr.	App. Purity	Total acidity*	Brix	Sucr.	App. Purity	Total acidity*
Nov. 13	0	16.54	14.06	85.0	2.05				-	15.73	12.56	79.8	2.50				-
" 22	9	17.19	14.94	86.9	-	17.74	15.01	84.6	-	15.94	12.90	80.9	-	16.74	12.72	76.0	-
" 29	16	16.44	13.98	85.0	-	17.87	15.11	84.6	-	15.94	12.54	78.7	-	16.94	12.74	75.2	-
Dec. 5	22	17.00	14.68	86.3	-	17.90	14.87	83.1	-	15.00	11.54	76.9	-	17.30	12.75	73.7	-
" 12	29	14.76	11.80	79.9	3.90	17.71	14.83	83.7	3.05	14.76	11.47	77.7	3.50	16.41	11.98	73.0	2.45
" 29	46	14.47	9.10	62.9	7.10	16.54	13.41	81.1	3.15	13.31	8.89	66.8	4.55	15.44	10.32	66.8	2.45

* 0.1 N NaOH per 10 cc. juice.

TABLE II

Changes in Brix, apparent sucrose, apparent purity, and acidity in standing, windrowed, 6- to 8-row heap-rows and 3- to 4-row heap-rows of five varieties exposed to freezing temperatures in November and December, 1950

Variety and Date of Analysis	Duration of experiment Days	Brix Degrees	Sucrose Percent	Purity	Gain (+) or loss (-) in: Brix Degrees	Sucrose Percent	Purity	Total * Acidity Cc	Juice Extraction Present
STANDING:									
C. P. 29/116									
Nov. 27, 1950	0	16.25	13.45	82.8	---	---	---	2.85	65
Dec. 5, 1950	7	15.89	13.08	82.3	- .36	- .37	- .5	2.93	--
Dec. 7, 1950	10	14.70	11.79	80.2	- 1.55	- 1.66	- 2.6	3.13	64
Dec. 18, 1950	21	14.74	10.83	73.5	- 1.51	- 2.62	- 9.3	3.73	49
Dec. 29, 1950	32	13.91	9.03	64.9	- 2.34	- 4.42	- 17.9	5.20	51
C. P. 34/120									
Nov. 27, 1950	0	17.43	15.35	88.1	---	---	---	2.45	61
Dec. 4, 1950	7	16.52	14.70	89.0	- .91	- .65	+ .9	2.32	--
Dec. 7, 1950	10	15.80	13.83	87.3	- 1.63	- 1.52	- .8	2.60	58
Dec. 18, 1950	21	14.24	11.39	80.0	- 3.19	- 3.96	- 8.1	3.70	41
Dec. 29, 1950	32	14.57	10.88	74.7	- 2.86	- 4.47	- 13.4	4.83	54
C. P. 36/13									
Nov. 27, 1950	0	17.42	15.64	89.8	---	---	---	1.90	66
Dec. 4, 1950	7	17.43	15.94	91.4	+ .01	+ .30	+ 1.6	2.10	--
Dec. 7, 1950	10	15.95	14.38	90.2	- 1.47	- 1.26	+ .4	2.43	64
Dec. 18, 1950	21	15.59	13.00	83.4	- 1.83	- 2.64	- 6.4	3.50	50
Dec. 29, 1950	32	15.22	11.93	78.4	- 2.20	- 3.71	- 11.4	4.30	53
C. P. 36/105									
Nov. 27, 1950	0	17.63	15.25	86.5	---	---	---	2.60	59
Dec. 4, 1950	7	16.59	14.42	86.9	- 1.04	- .83	+ .4	2.80	--
Dec. 7, 1950	10	15.60	13.42	86.0	- 2.03	- 1.83	- .5	2.98	57
Dec. 18, 1950	21	14.62	11.35	77.6	- 3.01	- 3.90	- 8.9	4.67	38
Dec. 29, 1950	32	14.36	10.88	75.8	- 3.27	- 4.37	- 10.7	4.45	41
C. P. 44/101									
Nov. 27, 1950	0	17.58	15.36	87.4	---	---	---	2.50	64
Dec. 4, 1950	7	17.30	15.30	88.4	- .28	- .06	+ 1.0	2.60	--
Dec. 7, 1950	10	16.80	14.82	88.2	- .78	- .54	+ .8	3.45	64
Dec. 18, 1950	21	16.01	13.89	86.8	- 1.57	- 1.47	- .6	3.25	49
Dec. 29, 1950	32	15.47	12.99	84.0	- 2.37	- 2.37	- 3.4	3.35	58

TABLE II (Continued)

Variety and Date of Analysis	Duration of experiment Days	Brix Degrees	Sucrose Percent	Purity	Gain (+) or loss (-) in: Brix Degrees	Sucrose Percent	Purity	Total * Acidity Cc	Juice Extraction Percent
WINDROWED:									
C. P. 29/116									
Nov. 27, 1950	0	16.25	13.45	82.8	---	---	---	2.85	65
Dec. 8, 1950	11	16.60	13.80	83.1	+ .35	+ .35	+ .3	2.98	64
Dec. 22, 1950	25	15.79	12.52	79.3	- .46	- .93	- 3.5	3.13	55
Jan. 2, 1951	36	16.18	13.00	80.3	- .07	- .45	- 2.5	3.50	54
C. P. 34/120									
Nov. 27, 1950	0	17.43	15.35	88.1	---	---	---	2.45	61
Dec. 8, 1950	11	17.57	15.69	89.3	+ .14	+ .34	+ 1.2	2.30	59
Dec. 22, 1950	25	17.58	15.27	86.9	+ 1.5	- .08	- 1.2	2.45	45
Jan. 2, 1951	36	17.66	14.82	83.9	+ .23	- .53	- 4.2	2.98	49
C. P. 36/105									
Nov. 27, 1950	0	17.63	15.25	86.5	---	---	---	2.60	59
Dec. 8, 1950	11	17.15	14.77	86.1	- .48	- .48	- .4	2.50	59
Dec. 22, 1950	25	16.67	14.20	85.2	- .96	- 1.05	- 1.3	2.73	48
Jan. 2, 1951	36	16.45	13.96	84.9	- 1.18	- 1.29	- 1.6	2.93	50
C. P. 44/101									
Nov. 27, 1950	0	17.58	15.36	87.4	---	---	---	2.50	64
Dec. 8, 1950	11	17.82	15.57	87.4	+ .24	+ .21	0.0	2.48	62
Dec. 22, 1950	25	17.90	15.57	87.0	+ .32	+ .21	- .4	2.40	55
Jan. 2, 1951	36	18.21	15.72	86.3	+ .63	+ .36	- 1.1	2.55	56
6- to 8-ROW HEAP-ROW									
C. P. 29/116									
Nov. 27, 1950	0	16.25	13.45	82.8	---	---	---	2.85	65
Dec. 4, 1950	7	16.24	13.40	82.5	- .01	- .05	- .3	2.83	--
Dec. 11, 1950	14	15.79	12.57	79.6	- .46	- .88	- 3.2	3.15	--
Dec. 22, 1950	25	16.34	11.81	72.3	+ .09	- 1.64	-10.5	3.85	50
Jan. 2, 1951	36	16.11	10.79	67.0	- .14	- 2.66	-15.8	5.00	48
C. P. 34/120									
Nov. 27, 1950	0	17.43	15.35	88.1	---	---	---	2.45	61
Dec. 4, 1950	7	17.62	15.90	90.2	+ .19	+ .55	+ 2.1	2.10	--
Dec. 11, 1950	14	17.18	15.26	88.8	- .25	- .09	+ .7	2.65	--
Dec. 22, 1950	25	16.74	14.23	85.0	- .69	- 1.12	- 3.1	2.50	41
Jan. 2, 1951	36	17.73	14.97	84.4	+ .30	- .38	- 3.7	3.00	43

TABLE II (Continued)

Variety and Date of Analysis	Duration of experiment Days	Brix Degrees	Sucrose Percent	Purity	Gain (+) or loss (-) in: Brix Degrees	Sucrose Percent	Purity	Total * Acidity Cc	Juice Extraction Percent
6-to8-ROW HEAP-ROW (Cont'd)									
C.P. 36/13									
Nov. 27, 1950	0	17.42	15.64	89.8	---	---	---	1.90	66
Dec. 4, 1950	7	18.09	16.79	92.8	+ .67	+ 1.15	+ 3.0	1.80	--
Dec. 11, 1950	14	17.99	16.48	91.6	+ .57	+ .84	+ 1.8	2.88	--
Dec. 22, 1950	25	16.94	15.13	89.3	- .48	- .51	- .5	2.00	51
Jan. 2, 1951	36	17.19	15.04	87.5	- .23	- .60	- 2.3	2.50	50
C.P. 36/105									
Nov. 27, 1950	0	17.63	15.25	86.5	---	---	---	2.60	59
Dec. 4, 1950	7	17.19	15.05	87.5	- .44	- .20	+ 1.0	2.65	--
Dec. 11, 1950	14	17.35	15.25	87.9	- .28	.00	+ 1.4	2.78	--
Dec. 22, 1950	25	17.65	15.10	85.6	+ .02	- .15	- .9	2.65	59
Jan. 2, 1951	36	16.94	13.41	79.2	- .69	- 1.84	- 7.3	4.10	43
C.P. 44/101									
Nov. 27, 1950	0	17.58	15.36	87.4	---	---	---	2.50	64
Dec. 4, 1950	7	18.17	16.24	89.3	+ .59	+ .88	+ 1.9	2.45	--
Dec. 11, 1950	14	18.07	16.06	88.9	+ .49	+ .70	+ 1.5	2.60	--
Dec. 22, 1950	25	17.82	15.40	86.4	+ .24	+ .04	- 1.0	2.68	51
Jan. 2, 1951	36	18.64	16.33	87.6	+ 1.06	+ .97	+ .2	2.78	53
3-to 4-ROW HEAP-ROW									
C.P. 29/116									
Nov. 27, 1950	0	16.25	13.45	82.8	---	---	---	2.85	65
Dec. 8, 1950	11	15.80	12.99	82.2	- .45	- .46	- .6	2.80	63
Dec. 15, 1950	18	16.36	12.11	75.0	+ .11	- 1.34	- 7.8	4.00	--
Jan. 2, 1951	36	15.93	10.67	67.0	- .32	- 2.78	-15.8	4.65	48
C.P. 34/120									
Nov. 27, 1950	0	17.43	15.35	88.1	---	---	---	2.45	61
Dec. 8, 1950	11	17.42	15.82	90.8	- .01	+ .47	+ 2.7	2.15	60
Dec. 15. 1950	18	17.74	15.42	86.9	+ .31	+ .07	- 1.2	2.65	--
Jan. 2, 1951	36	17.63	14.21	80.6	+ .20	- 1.14	- 7.5	3.85	45
C.P. 36/13									
Nov. 27, 1950	0	17.42	15.64	89.8	---	---	---	1.90	66
Dec. 8, 1950	11	18.04	16.90	93.7	+ .62	+ 1.26	+ 3.9	1.63	67
Dec. 15, 1950	18	18.39	16.81	91.4	+ .97	+ 1.17	+ 1.6	2.05	--
Jan. 2, 1951	36	17.98	15.69	87.3	+ .56	+ .05	- 2.5	2.50	54

TABLE II (Continued)

Variety and Date of Analysis	Duration of experiment Days	Brix Degrees	Sucrose Percent	Purity	Gain (+) or loss (-) in: Brix Degrees	Sucrose Percent	Purity	Total * Acidity Cc	Juice Extraction Percent
3-to 4-ROW HEAP-ROW	(Cont'd)								
C. P. 44/101									
Nov. 27, 1950	0	17.58	15.36	87.4	---	---	---	2.50	64
Dec. 8, 1950	11	18.02	15.87	88.1	+ .44	+ .51	+ .7	2.63	64
Dec. 15, 1950	18	18.24	16.16	88.6	+ .66	+ .80	+ 1.2	2.88	--
Jan. 2, 1951	36	18.04	15.09	83.6	+ .46	- .25	- 3.8	3.03	53

* 0.1 N NaOH per 10 cc. juice.

U. S. D. A. SUGARCANE HARVESTER DEVELOPMENT

by R. M. Ramp, Sr. Agricultural Engineer, and
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Prepared for the Meeting of the Agricultural Section of the American Society of Sugar Cane Technologists on February 21, 1952 at Baton Rouge, Louisiana

In the early 1930's approximately 60 man-hours were required to cut and strip an average acre of sugarcane in Louisiana. Today, with the present method of harvesting, approximately 7 man-hours are required to cut and pile an acre. When cane was cut by hand the trash was removed with the cane knife at the time of cutting. Now, mechanical cutters cut the canes top and bottom and pile them into heap rows where the trash is removed by burning. In the average harvesting season 2 to 4 days of favorable weather are required for the trash to dry sufficiently for satisfactory burning. During rainy periods the cane must be milled with the trash. Long delays in milling or milling with adhere trash result in appreciable losses in recoverable sugar.

The main objective of mechanizing sugarcane harvesting is to develop equipment and methods that will assure the maximum economical recovery of sugar per acre. We believe that in order to meet this objective the harvesting method must fulfill the following requirements:

1. Proper cutting at top and bottom.

2. Separation of trash, in the form of leaves, tops, and mud, from millable cane.

3. Delivery for processing within 24 hours or less after cutting.

During the past three sugarcane harvesting seasons the efforts of the Sugarcane Machinery Project of the U. S. Department of Agriculture at Houma, La. have been concentrated on the development of a harvester that would fulfill the above requirements. Considerable time and effort have gone into the development and testing of the various units illustrated in the following pictures and drawings.

Figure 1. Experimental U. S. D. A. harvester in operation

The experimental U. S. D. A. harvester illustrated in Figure 1 is a fourwheel, self-propelled unit. The front wheels are equipped with 18 x 26 rice and cane field tires for propelling the harvester. Steering is done by the rear wheels aided by wheel brakes on each of the front wheels. The steering wheels are actuated hydraulically for short turning at the headland and to decrease the operator's steering load. Power for propelling as well as operating the harvesting mechanism is supplied by a 69 hp. high speed gasoline engine. The propelling axle is powered from the engine

by means of a HL agricultural adjustable speed belt drive through a variable sheave. This driving arrangement and the axle transmission provide a ground speed range of 0.96 to 10.85 miles per hour. Power for operating the harvesting unit is transmitted from the engine to the main clutch shaft by multiple V-belts.

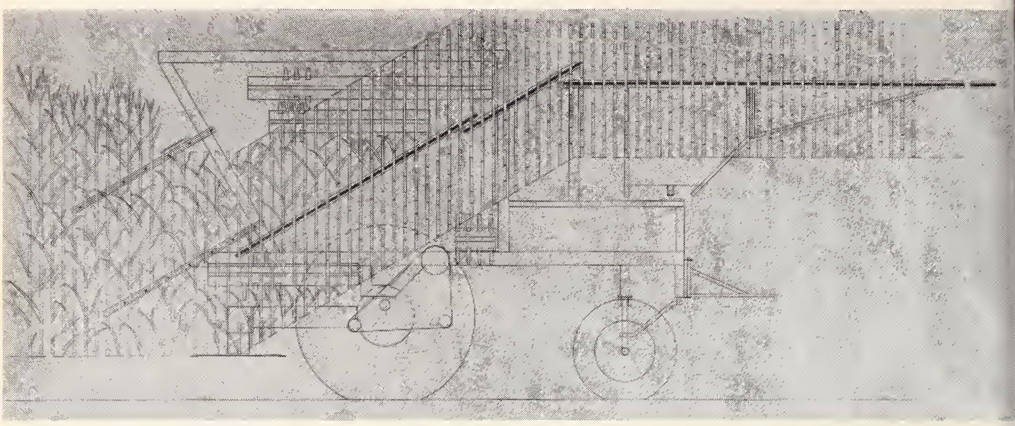

Figure 2. Profile drawing of U.S.D.A. harvester

This drawing (Figure 2) illustrates the operation of the harvester and shows the essential units that operate on the canes. The canes are moved straight through the harvester except for the final side loading operation. The upper and lower gatherer units are located ahead of the front wheels and serve to bring the canes into a line for transmission through the cutting and detrashing units. The upper gatherer is equipped with a hydraulic-driven topper blade for pretopping the canes ahead of the detrasher. This assembly has an adjustment range of 44 to 92 inches to meet varying field conditions. The canes are normally topped before they are cut at the ground. The ground cutter consists of two 35-inch diameter disks equipped with heavy mower sections for their cutting edges. These sections are spaced approximately 9 inches apart around the periphery of the

disk. The two disks are timed and over-lapped so that the cutting sections do not interfere with each other but effectively cut the entire row. Their direction of rotation aids in moving the canes into the machine. Immediately after the canes have been severed from the ground they are engaged by the sticker elevating conveyor which elevates the canes as they are moved through the detrashing units. The conveyor consists of a D-60 roller chain equipped with stickers on the outer side bars. A No. 60 plain roller chain is used opposite the sticker chain to hold the canes in contact with the stickers. The elevating sticker conveyor lifts the canes approximately 68 inches vertically in a horizontal travel of 120 inches.

Whole cane, as standing in the field, contains approximately one-third trash and two-thirds millable cane by weight. Approximately 50 percent of the total trash is removed by the topper. In 20-ton cane the tops represent approximately 5 tons of trash per acre. This leaves 5 tons of trash, mostly in the form of leaves, to be removed from the entire millable length of cane. The distribution of this trash varies considerably depending upon variety and maturity of the canes; however, in general, the larger part of this trash is located on the upper half of the canes as illustrated graphically in Figure 3.

The trash on the millable cane is removed in two operations. The trash on the lower part of the canes below the sticker conveyor is combed downward by two horizontal stripping cylinders located directly beneath the sticker and starting approximately at the point where the canes are engaged by the sticker. These cylinders are equipped with rubber fingers and are timed and rotated to comb downward as the canes are moved lengthwise and upward through the stripping cylinders. The entire lower section of the canes is completely stripped of all the trash and weeds in a horizontal travel of approximately 48 inches. The trash from the upper section of the canes and above the sticker conveyor is removed by the upper stripping unit consisting of four horizontal stripping cylinders similar in construction to the ones used to strip the lower section. The two lower, or feed, cylinders are timed so that the rubber stripping fingers do not interfere with each other and are rotated to comb upward on the canes. They are spaced closer together than the upper pair to aid in confining the upper section of the canes to a line. The two upper cylinders are located above the feed cylinders and their cores are separated more to allow for the spreading of the canes during the

stripping operation. The upper cylinders are rotated to comb down as the canes move upward and rearward through the stripping unit. The trash removed by the stripping unit is discharged horizontally from both sides and is deflected downward onto the front tires.

Trash from the zone where the canes are gripped by the sticker is removed by the lower strippers before the canes are engaged by the sticker elevating conveyor and trash at the rear transfer point is removed by the upper stripping cylinders.

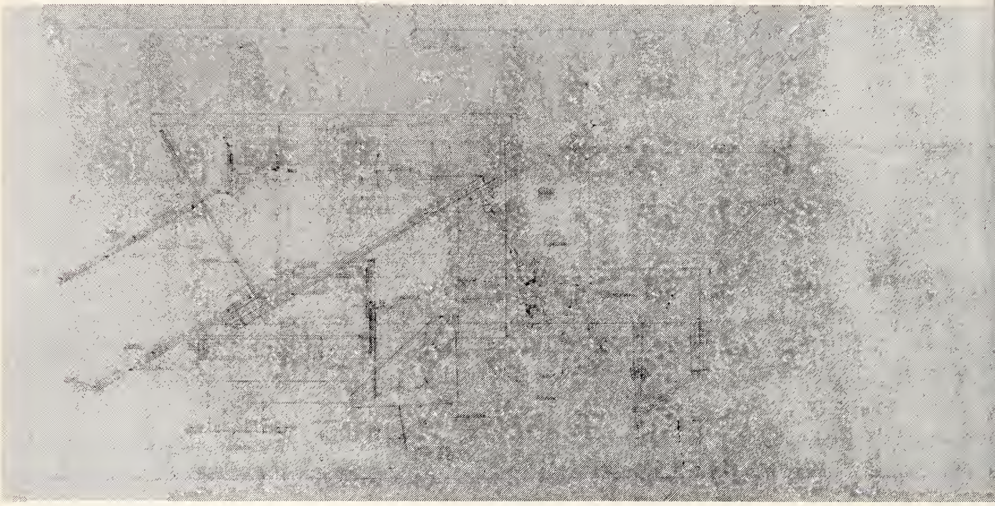

Figure 4. Detail drawing of **U. S. D. A.** sugarcane harvester

After the canes have been cut and stripped they are ready for loading. To open a field the harvester is equipped with a rear hitch for pulling the cart directly behind. The clean canes are conveyed from the elevating sticker chain to the cart by means of the horizontal loading arm. This arm consists of a single sticker chain with a backing channel to hold the canes in contact with the sticker. The rear 9-foot section of the backing channel is hinged at the front so the backing can be moved away from the rear 9-foot

section of the sticker chain. To load the rear of the cane cart the hinged backing is closed hydraulically and forces the sticker chain to discharge the canes from the end of the chain into the cane cart. The size of the opening in the hinged backing varies the point of cane discharge into the cane cart. The entire loading arm is swung horizontally, thereby enabling the loader operator to place the canes in any position in the cane cart from front to rear and from side to side.

When direct loading to the rear is used it is necessary to attach and detach the cane cart from the harvester. A hydraulically adjustable hitch on the cart tractor made it possible to attach or detach the cart in approximately 1 minute. Further improvement in the hitch will reduce this time.

In order to side load, two adjacent cane rows per field unit must be cut utilizing direct rear loading. For side loading the rear loading arm is turned at approximately 45 degrees with respect to the harvester travel. The canes are conveyed over the cut cane rows until they are directly over the cart row. A short conveyor section is provided at the end of the arm to align the canes parallel to the row before they are dropped into the cart.

The rear loading arrangement on the harvester operated very well, but further improvements are needed on the side loading operation for this phase of the operation to be as satisfactory as the rear loading.

The experimental harvester was operated intermittently from November 15 through December 19, 1951. During this period approximately 100 tons of cane were harvested and delivered. Trash samples were taken at random during the harvest period. The trash content of these samples varied from 0.67 to 3.6 percent. The 46th load, cut on December 19 during a rain, contained 1.61 percent trash. The trash content of all the cane cut by the experimental harvester during the season was low. Most of the cane was loaded by the rear loading arrangement. The loads varied from 1.49 to 3.4 tons with an average load for the season of 2.391 tons.

EVALUATION STUDIES ON CANE VARIETIES
A STUDY OF MILLING CHARACTERISTICS

Supplement I

by E. R. Goodell and Carl W. Stewart

This is a summary of work done on this subject at the Audubon Sugar Factory, Louisiana State University during the 1951 season. The report was submitted at the annual meeting of the society in February 1952.

The work covered in this report is a continuation of studies inaugurated along this line in 1950 and subsequently reported in Engineering Experiment Station Bulletin No. 24, Louisiana State University. For details of procedure the bulletin should be consulted.

The test program involved a comparison of the results obtained in milling new varieties of sugar cane using a commercial variety, CP 36-105 as a standard. The number of tests on the new varieties varied from one to four each depending on the amount of cane available. Sixteen separate tests were made on the reference variety CP 36-105. Abnormal growing season coupled with a series of early freezes resulted in rather poor quality cane as regards pol and purity values.

Varieties tested included the following:

CP 36-13	CP 44-154
CP 36-105	CP 44-155
CP 43-47	CP 45-165
CP 44-101	CP 45-184

The outstandingly good varieties (based on this series of tests) were CP 44-101 and CP 44-155. CP 43-47 was better than the CP 36-105 used as a standard. All of the other varieties appeared inferior to CP 36-105.

CLEAN, FRESH CANE--HOW MUCH IS IT WORTH?

by Richard H. Bianchi and Arthur G. Keller

Abstract

This is a report on a series of tests made at the Audubon Sugar Factory, Department of Chemical Engineering, Louisiana State University, during the crop of 1951-52. Complete milling data was obtained on lots of cane from the same fields. Comparison was between cane harvested by the conventional 'Hurrycane Harvester' and that harvested by the 1951 model harvester-cleaner-loader of the Thompson Machinery Co. of Thibodaux, Louisiana. A total of sixteen pairs of tests were made. A summary of the findings follows:

The new harvester delivers cane with less than one half the trash content of the conventionally harvested cane, 2.71% vs. 5.94%. More than 75% of the deliveries from the new machine were less than 3.00% trash and only one delivery was over 6% trash, while 35% of all conventionally harvested cane was over 7% trash.

Pol and sucrose on cane from the new harvester averaged 0.60% and 2.63% higher than did tests on cane from the same field harvested by conventional methods. On the average, cane from the new harvester was 1-1/4 days from cutting to milling while conventionally harvested cane was 3-1/4 days.

Loss in pol extraction averaged about 0.40% per 1% trash on gross cane. This value checks very closely with the value determined in a similar study during 1950 of 0.364%.

Based on an assumed cane price of $7.14 per standard ton, and a benefit payment of $1.20 per standard ton, the advantage to the grower of delivering clean, fresh cane over what he would obtain by delivering burned cane was $0.626 per ton gross cane delivered. When cane was unburned because of weather or for other reasons the advantage price-wise was $1.517 per ton of gross cane delivered. For the season (average of all runs) he would gain an average of $0.910 per ton weight delivered from the harvester-cleaner-

loader compared to the conventional harvester practice.

Previous studies have shown that the cost to the processor of trash is 1.85% of the value of a ton of cane for each 1% trash in the material delivered. On this basis the saving to the processor would have averaged for the season (twenty runs) $0.300 per ton material delivered. With well burned, reasonable fresh cane the savings would be $0.187 per ton gross cane delivered. During periods when cane is unburned the savings would be $0.516 per ton on the material handled. Combined savings to a Grower-Processor would average for the crop period, $1.210 per ton gross cane delivered. Under worst conditions (wet weather) savings would rise to $2.033 per ton gross cane delivered.

Savings to the industry as a whole through the use of clean, fresh cane compared to grinding cane harvested by current practices would have totaled about $6,050,000 for the 1951 crop.

N.B. This work was published as Engineering Experiment Station Bulletin No. 28, Louisiana State University, Baton Rouge. For further information consult the bulletin.

A SECOND SEASON OF PILOT-PLANT PROCESSING OF SUGAR CANE

by W. F. Guilbeau, C. L. Black and L. F. Martin

Sugarcane Products Division, Southern Regional Research Laboratory

Abstract

Experiments on processing juice from samples of only two to three tons of cane at rates as low as 40 to 60 gallons per hour were carried out for the first time during the 1950 crop at the Audubon Sugar Factory, Louisiana State University. Operation of this small pilot plant exceeded expectations as to its performance and much useful and interesting data were obtained on the ten different varieties of cane which it was possible to study that year.

The general plan of the 1951 studies was similar to that followed in 1950, but a larger number of samples were tested and more information was obtained one each sample. This was possible in spite of the shorter period of operation as a result of the very adverse weather conditions prevailing during the campaign.

Varieties studied and the number of tests on each were:

CP 34-120 (4)	CP 44-155 (2)
CP 36-105 (3)	CP 44-101 (1)
CP 43-47 (4)	CP 45-165 (1)
CP 44-154 (4)	CP 36-13 (1)
CP 45-184 (4)	Co 290 (1)

These pilot plant processing tests on a number of the newer varieties during a second campaign has confirmed the value of such experiments as a means of providing information which can be helpful to the factories in processing them as they are increased to replace older varieties. As in the case of the 1950 experiments, the number of tests was limited and variations between duplicate tests which were averaged should be kept in mind. A much larger number of experiments on replicated samples would be necessary to establish the significance of minor differences, which would limit the experiment to a study of only one variety during an entire season. Gross differences in behavior are determined with sufficient accuracy to provide information on what

may be expected in commercial processing of the canes tested. The larger volumes of mud and lower processing rates to be expected from certain varieties as compared to others can be checked consistently, and was generally the same this season as last. The additional data show consistent tendencies of certain varieties to produce darker juices. The excellent processing qualities of variety C.P.44-155 as stubble cane confirm the results of last season's tests of its performance as plant cane.

The complete paper was published in the June 1952 issue of the Sugar Journal and should be consulted for further information.

ANALYTICAL STUDIES ON THE JUICES OF SUGARCANE PROCESSED ON A PILOT-PLANT SCALE

by C. A. Fort and B. A. Smith

Sugarcane Products Division, Southern Regional Research Laboratory, New Orleans, Louisiana

Abstract

The studies carried out at the Audubon Sugar Factory of Louisiana State University during 1950 and 1951, of the milling and processing quality of newer varieties of cane (1, 2) included a detailed investigation of the composition of the raw and clarified juices. In the pilot plant work the operation was controlled and the results were interpreted on the basis of the usual routine determinations of apparent purity, Brix, and apparent sucrose. While such data serve for comparison of <u>how</u> the samples behaved in milling and clarification, much must be known of the juice composition, and more accurate balances on the elimination of individual constituents must be determined in order to arrive at an understanding of <u>why</u> they behaved as they did. This report summarizes the results of such analytical studies completed during and subsequent to both 1950 and 1951 campaigns. These data include the determinations on both the raw and the clarified juices, the dry solids, true sucrose, reducing substances, silica carbonate and sulphated ash and specific conductivity. In addition in the campaign just past there were determined phosphates, sulphates, chlorides, aconitic acid, lime, magnesia and nitrogen. Not all the cane came from the same field so it cannot be concluded that the differences in value indicate varietal characteristics; however, in certain instances the comparative figures have some significance in this direction and these are pointed out in the discussion.

The four C.P. varieites 34-120, 43-47, 44-154 and 45-184 in both seasons came from corresponding fields and may be compared with one another with fair confidence. In 1950 the other three varieties, Co.290, C.P.44-155 and 44-101 came from the local fields, but in the 1951 campaign came from the Lafayette area. The C.P. 36-105 of this last year came from

local area but a different field than the first four varieties mentioned.

The data are submitted in six tables. A discussion of each table emphasizes where possible the influence of varietal characteristics. The complete article which was published in the December 1952 issue of the Sugar Journal should be consulted for further information.

EVAPORATOR SCALE

by Nat. A. Bailey, Technical Director

Wright Chemical Corporation

If the clarified cane juice or sweet water that is sent to the evaporator contained only sugar, its concentration would be a comparatively simple and efficient process. Unfortunately, the clarified cane juice, with which we will deal primarily in this short discussion, also contains considerable foreign matter which causes fouling of the evaporator tubes by depositing as scale. The scale formed is a good heat insulator, and it is not long before reduction of heat transfer in the evaporator so reduces its capacity that it becomes necessary to shut down for a cleanout. In many mills that have no standby evaporator capacity this means shutting down the mill and adds the cost of loss of production to that of labor and chemicals for the cleaning process.

Scale that forms on the tubes of the evaporator is composed primarily of mineral matter, its content usually varying from 70% to as high as 95%. The primary source of the mineral matter is the ash of the cane itself which, although amounting to only a few tenths of one percent in the ripe cane, may reach a value of one percent or more in the juice expressed from it in some cases. The ash content of cane and its mineral composition depend upon the variety, the climate, the soil, the fertilizer used, the time of cutting and other factors, among the latter being the cleanliness of the cane when ground which has a marked effect upon the mineral content of the juice obtained. In addition to mineral matter, the juice leaving the mill also contains organic nonsugars in appreciable amounts, which must be removed as completely as possible before it is sent to the evaporators and pans or the quality of the sugar will be adversely affected. The universal method of removing these materials in the sugar mill is by the addition of lime, often in combination with phosphoric acid and various other chemicals, but the defectation or clarification that results is due primarily to the action of line. The addition of lime has the effect of converting highly soluble non-scale forming

salts to less soluble calcium salts, an appreciable amount of which remain in solution in the juice and enter the evaporator where they deposit as scale.

A very interesting article entitled "A contribution to the Clarification of Cane Sugar Juices" by Doctor Pieter Honig appeared on page 31 of the June, 1952 issue of Sugar. In his discussion of the use of sulphur dioxide in clarification, Doctor Pieter Honig gives a table showing the variation in the content of removable non-sugars present in mixed juice which we have taken the liberty of reproducing here, calling it Table 1.

Table 1

Variations in Amounts of Removable Nonsugars
Present in Mixed Juice (mg/l)

Organic Nonsugars:		
Waxy matter, total		300-800
	hard cane wax	100-300
	soft cane wax	200-350
	phosphatides	20-50
	proteins, total	150-1000
	phospho proteins	20-50
	pentosans (gums)	100-500
Inorganic Nonsugars		
Cations:		
	CaO	200-800
	MgO	120-800
	Fe_2O_3	50-300
	Al_2O_3	30-200
Anions:		
	P_2O_5	100-800
	SiO_2	300-1000
	SO_3	300-1000

In order to illustrate what may be expected in the way of salts dissolved in the juice, the higher values of inorganic nonsugars in this table have been calculated to hypothetical combinations, and the results, after rounding off, are given in the same units (mg/l) in Table 2.

Table 2

Calcium sulphate ($CaSO_4$)	1700
Calcium phosphate ($Ca_3(PO_4)_2$)	200
Magnesium phosphate ($Mg_3(PO_4)_2$)	1200
Magnesium silicate ($MgSiO_3$)	500
Mixed iron & Aluminum silicate	
(R_2O_3)(SiO_2)	200
Silica (SiO_2)	

It is true, of course, that these are possible, but not probable combinations, although most of them very likely do exist in evaporator scale deposited from clarified juice in the form given.

Clarification, if well performed will remove a large part of the salts enumerated, and in order to illustrate what may be expected regarding mineral salts in clarified juice, the following average analysis, calculated to hypothetical combinations and expressed in milligrams per liter is given:

Table 3

Average Mineral Content of
Clarified Juice Entering Evaporator
(mg/1)

Calcium sulphate (Ca O_4)	630
Calcium phosphate ($Ca_3(PO_4)_2$)	100
Magnesium phosphate ($Mg_3(PO_4)_2$)	230
Magnesium silicate ($MgSiO_3$)	60
Mixed iron & aluminum silicate	
(R_2O_3) (SiO_2)	50
Silica (SiO_2)	70

This table is an average of a number of analyses of clarified juice from various localities taken from our records. The total amount of mineral matter is only about 0.1 gram per liter or a little over 0.01 ounce per gallon, but it is all potentially scale-forming and it does not require very much time for enough scale to deposit on the tubes of the evaporator to seriously slow it down. It follows, therefore, that the greater the elimination of mineral matter

from the juice the longer the run obtained in the evaporator.

Whenever water is evaporated from a solution of crystallizable material, the concentration of that material gradually increases until the solution becomes supersaturated and crystals begin to form. The limit of solubility of the substance in solution determines the amount of concentration required for crystal formation; thus, if its solubility is low, crystallization will begin after a comparatively small increase in concentration. All of the compounds listed in Table 3 belong to this category, although practically all of them are more soluble in dilute sugar solution at a given temperature than in water at the same temperature. As the sugar content of the solution is increased, however, the temperature being held constant, the solubility of the compound decreases. This is particularly true of the sulphate, carbonate and oxalate of calcium, the latter often being present in clarified juice. In addition, some of them notably calcium sulphate, have an inverse temperature-solubility curve, which means that as the temperature rises the solubility decreases without evaporation taking place. In the case of materials probably largely present in the colloidal state, such as the (R_2O_3) (SiO_2) combinations, silica, and some of the organic nonsugars such as protein and wax, it is probable that their separation is due largely to a "salting-out" process caused by increase in sugar concentration, plus the effect of heat on the organic non-sugars particularly, rather than to an increase in concentration of the specific colloidal material in question. The factors just mentioned also determine the composition of the scale formed in each effect of the evaporator to a considerable extent.

In the sugar mill the heaviest deposit of scale occurs in the last two effects of the evaporator, while in the refinery the heavi est deposit is formed in the first two effects. The type of scale found in these cases is also the most refractory, that is, the most difficult to remove in the boilout. In the Cane Sugar Handbook, Spencer & Meade, Eighth Edition, 1945, on page 173, the authors quote a series of analyses of scale from the four pans of a quadruple effect evaporator published in Kobus Archief by Prinsen-Geerligs which shows the variation from effect to effect nicely. These analyses are quoted below:

Table 4

	First Pan %	Second Pan %	Third Pan %	Fourth Pan %
Calcium phosphate	57.85	56.98	15.02	7.49
Calcium sulfate	2.02	1.92	0.54	1.65
Calcium carbonate	3.25	4.68	19.55	9.93
Calcium silicate	7.86	13.31	0.71	7.02
Calcium oxalate	-----	-----	11.32	11.27
Iron oxide	2.03	1.53	2.31	2.58
Silica	7.70	7.43	39.26	54.34
Combustible matter	20.37	13.41	11.04	5.08

Inspection of these analyses shows that the scale in the first two effects is made up primarily of calcium phosphate, although appreciable amounts are also present in that from the last two effects. In the third and fourth effects silica is the main constituent, which is the reason the deposits in these effects is so hard to remove. The content of calcium oxalate in the last two effects is somewhat higher than we have found to be the usual case. Note that the content of combustible matter, which is made up primarily of the organic non-sugars in the juice,progressively decreases through the four effects of the evaporator. Separation of this material is due partly to heating, which has a coagulating effect upon it, and partly to change of pH caused largely by separation of the inorganic nonsugars. Since the organic nonsugars are mostly colloids, they exert a protective effect upon the inorganic nonsugar colloids, silica and the silicates, as long as their concentration is high enough. However, by the time the syrup reaches the third effect of a quad, for example, their concentration is reduced to such an extent that they can no longer exert their protective effect and the inorganic colloids begin to separate.

Analyses of evaporator scale we have made in our laboratories follow that in Table 4 in a general way, but considerable variation is introduced by location, type of cane, method of clarification, and so forth. In order to illustrate this we have selected a few analyses from our files and give the composition of scale from the fourth effect in Table 5 in order to show the variation that may be expected.

Table 5

Scale from Fourth Effect - Sugar Mill Evaporators
Hypothetical Combinations - % Dry Basis

	Louisiana	Florida	Cuba	Puerto Rico	Mexico	South Africa
Calc. phosphate	3.05	2.94	8.82	6.30	2.55	0.95
Calc. sulfate	17.48	57.95	1.48	1.46	9.86	59.51
Calc. oxalate	1.52	trace	trace	1.05	trace	-----
Calc. silicate	7.21	-----	16.96	0.79	1.78	6.10
Magn. silicate	0.72	0.94	5.74	-----	-----	-----
Silicate	42.40	7.65	20.15	58.85	52.03	12.11
Iron oxide	0.11	trace	0.37	0.03	0.10	0.27
Organic and undetermined*	27.51	30.52	46.12	31.57	33.76	21.06

*Includes alkali metals, trace elements, etc.

Of course, the best way to prevent scale formation in a sugar mill evaporator would be to remove all mineral matter and precipitable organic matter from the juice entering it. This probably could be done, but it is likely that the cost would be considerably higher than that of cleaning the evaporator. Some progress toward removal of the inorganic nonsugars has been made with the use of deionizing equipment, but the initial cost of equipment is reported to be high, the organic nonsugars interfere with operation of the beds, removal of siliceous constitutents of the juice is unsatisfactory, and unless very careful control is used, there is danger of inverting an appreciable amount of sugar.

Another method of approaching the prevention of scale deposition in evaporators is available, however, which is to so condition the syrup that scale-forming materials will not separate, or if they do separate, it will be in such a form that they will not adhere to the tubes. This has been common practice for many years when dealing with boilers, heat exchangers, and so forth, but as near as can be determined, was not applied to sugar mill or refinery evaporators until about twelve or fifteen years ago. The first materials used for the purpose were the polyphosphates, which have the property of forming soluble salts with such scale-forming

ions as calcium, magnesium, iron and aluminum, and will hold them in solution for a considerable period of time. Under evaporator conditions it does not take long for the polyphosphates to revert to orthophosphates, the salts of which with the ions just mentioned are insoluble, and will adhere to the tubes to form phosphate scale. In addition, polyphosphates will not prevent the formation of silica or silicate scale. For these reasons the use of such compounds has been only moderately satisfactory.

Another method of conditioning the scale forming materials that separate from water in boilers and kindred equipment so that they do not adhere to the confining walls, is by the use of organic colloids. You will remember that attention was called to the fact that the naturally-occurring organic colloids in cane juice appear to hold the inorganic colloidal materials in suspension up to the point where the concentration of the former is so reduced by the action of heat and change of pH, that they can no longer exert their protective effect. If, now, an organic colloid which is not as sensitive to heat and pH were added to the juice, it would be present at the point where silica and silicate scale-forming material begins to separate, and would so condition the precipitate that it would adhere to evaporator tubes. Experimental work and experience have shown that such is actually the case, and in some instances operators were able to run the evaporators with only one or two boilouts during a grinding season. The organic colloids used must be comparatively stable with regard to temperature and change of pH, must not increase the color of the syrup or the final sugar, and also must not affect crystallization of sugar in the pans. Such colloids exist, and are not too expensive to effect a saving over the cost of cleaning evaporators. They must be used in the right proportion, however, and in order to reduce the amount required and also give more satisfactory results, addition of the proper amounts should be made at several points in the evaporator rather than addition of the total amount required at a single point, When used in this way, such colloids are capable of giving very good results, and are at present in use in mills all over the world.

THE APPLICATION OF TETRA PHOSPHO GLUCOSATE FOR SCALE CONTROL IN SUGAR EVAPORATION

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Tetra Phospho Glucosate* has been used as a scale inhibitor in sugar evaporators since 1942 with varying degrees of success. The results range from a full seasons operation without boiling out to a premature discontinuance of the treatment following a single short run of less than 100 hours. In view of these wide discrepancies in results it is felt appropriate that a review be made of the basic properties of this inhibitor together with factors governing its application.

Sugar juices represent organic solutions consisting essentially of sugars and of salts of inorganic and organic acids, molecularly dispersed, but contain also small quantities of material of colloidal dimensions.[5] The colloid content of these juices consists of those colloids which occur normally in the producing plant as well as those derived from external sources. Material inherent to the plant structure include proteins, fats and waxes, gums and pectins, coloring matters (including tannins), lime, silica and starch. Colloids not normal to the plant saps may include coarse dispersoids and colloids derived from the soil by harvest techniques, colloids extracted from or produced by the action of heat and lime upon fine particles of fibre or marc, colloids produced by fermentation due to unsanitary handling or storage facilities and colloids produced by injury to the plants from abnormal cultural and climatic conditions or even by diseases or freezing.

Varying colloid phases along with the various degrees or ionization among salts in the aqueous phase in contact with the organic phases represent an extremely complex solution, where areas of influence will vary in relation to the strength or activity of the fields of each organic phase present. Inorganic ions commonly associated with evaporator deposits exist for the most part, if not all, as colloidal dispersions in the juices. The physical phenomena that are

encountered in these colloidal organic liquors cannot be predicted from day to day or run to run due to the various secondary phases that occur and are recurring in nature through the plant life processes.

The application of Tetra Phospho Glucosate[6] is toward a physical and colloidal effect preventing the complete rearrangement of the mass concentration of the ions that form or precipitate as scale. The application deals with the colloidal phenomenon of dispersion which approaches the intricate contact of the sensitive fields of colloidal influence of the Tetra Phospho Glucosate that is being introduced, which in an independent function from the mass concentration of the inorganic salts present and is also an independent function of the type of sugar or sugar complexes. The area of influence of unlike charges and unlike colloids will definitely cause a migration of adsorbed ions from one colloid to a more active migratory colloid in which the ions may move more freely or with a lower free energy, and it is to this end that the efficiency of Tetra Phospho Glucosate in this application is dependent.

Attempts to consider the control of these scale problems on a simple weight reaction basis have met with failure. Inorganic phosphates have been attempted as a means of control following such a train of thought. Others have attempted and are attempting an analytical approach which can be of little value in practical control, since the complexities involved will not yield to a simple set of analytical procedures. The complexities of the physical phenomena involved in the mass concentrates of organic liquors containing variable percentages of mineral salts and colloids, each of which bear different solution phases or ionization effects to each other, cannot be held within the confines of stoichiometric chemistry and therefore cannot involve the use of analytical techniques as a means of prediction, control or interpretation.

Sugar juices being concentrated by evaporation are in a state of accelerated activity due to the application of heat and more intimate contact of the phases by concentration. Areas of influence will change constantly and there will be an increase in the complexity of the phenomena that will occur in the course of activity toward states of lower free energy or colloidal stability among the active migratory colloids. This in turn will affect the precipitation of inorganic salts that may

be released to the aqueous phase to the point of saturation or supersaturation at the heat transfer surfaces. Colloidal dispersion would bear a time factor with the field of influence of the active colloid and it has been noted that the addition of an active colloid may eliminate scale formation in the primary effects with no benefit to latter effects and in some cases may result in increased scale formation in the latter effects.

Early work at the Chalmette Refinery of the American Sugar Refining Company, [1, 2, 4] indicated a good degree of control with Tetra Phospho Glucosate in a refinery operation under good evaporation and clarification practices. This control was possible under those conditions with one point of injection ahead of the evaporators. This application was later extended into foreign raw factories and comparable results have been obtained in several areas. The application has been particularly successful with raw juice in the Hawaiian area as reported by Anderson, [3] Hewlett, et al, [7] and Hopper [8].

Multiple effect evaporators handling juices from certain areas cannot be adequately protected throughout all effects by a single injection of Tetra Phospho Glucosate ahead of the first effect. Good control can be obtained in as many as the first three effects, but control is lost on the last or last two effects. An increase in injection often helps in the control of these latter effects but the increase required is usually excessive in relation to the results obtained.

For several years a number of plants have followed a procedure of multiple injection with good results. This procedure involves injection ahead of the first effect in the usual manner at an optimum injection rate. This is followed by secondary injection between effects, just ahead of the effect that first fails to correspond to the degree of control desired. This secondary point of injection is usually ahead of or after the third effect and in most cases only one secondary point of injection is required. Some benefit is experienced in the last effect from the primary point of injection, but the control is not always as good as desired so the secondary injection is made at low dosage to increase the control at those points. The ratio of feed into the primary and secondary points of injection normally range 80%-20% to 60%-40%. Pichardo, et al, [9] have published a report of successful control following such a procedure with Tetra Phospho Glucosate.

Tetra Phospho Glucosate is a colloid which is effective in controlling scale in sugar evaporators at an economical cost. Its application in sugar juices is not subject to analytical

control but its application can be adjusted to a practical control basis consistent with individual conditions. There are some conditions where the control cannot be expected to be satisfactory, such as in cases of heavy mud contamination or improper clarification practice, although good results have been obtained in some raw plants where an unusually large amount of field trash is encountered. In some cases improved control is made possible through a change in the organic structure of the treatment where the Tetra Phospho Glucosate might be blended with other poly-glucoside derivatives, and the plant should cooperate with the manufacturer in this regard.

Factors which oftentimes are overlooked in the application of Tetra Phospho Glucosate or the glucoside derivatives may lie in the type of water used in preparing the solution of Tetra Phospho Glucosate for dispersion into the various streams or evaporators where scaling tendencies are the object to be controlled. Waters that are usually encountered in certain areas may have a high ionization factor along with inorganic ions adsorbed to extraneous colloidal matter, which will affect the reorientation or adsorption degree of Tetra Phospho Glucosate prior to introduction into these streams. The quality of water should be very clear and soft in order to avoid complex ions in the solution state prior to introduction. Some plants have adopted large distilled water mixing vats ranging from 3000 to 5000 gallons capacity and prepare their solution to be charged at a faster rate into each effect or point of injection.

In the use of clear, soft, or distilled water, an increased effect will always be encountered in the control of scale deposition in these evaporators. It is also recommended that the rate of feed to the first, second or third effects be increased in order to allow an increased dispersion rate into the stream to the evaporator which will avoid mass concentration in localized areas which may reduce the normal effects in the area of influence where adsorption and reorientation factors are involved. This will allow a more uniform adsorption rate to the last concentration where variables may be encountered in the runs from hour to hour or day to day.

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SOME SUGAR JUICE AND EVAPORATOR DEPOSIT ANALYSES FOR LOUISIANA AND FLORIDA MILLS

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Several years ago the writer in a paper before the Sugar Technologists Group at Santiago, Cuba (1) stressed the fact that scaling of sugar evaporators would be expected when the analysis of the juice in most mills is considered. Furthermore, it was pointed out that more complete removal of certain nonsugars would be necessary to appreciably improve evaporator deposit problems. In that paper the following data from Honig were cited as being characteristic of a "normal" or "ideal" juice:

	Concentration, ppm					
	Low		Medium		High	
CaO & MgO	300		400-500		600	
MgO	100		100-200		200	
Fe_2O_3	20	25	30- 40	50	45	70
Al_2O_3	5		5- 20		25	
P_2O_3	30		40- 70		100	
SO_4	300		300-400		600	

Needless to say the clarified or defecated juice in Louisiana and Florida by no means meets these requirements. Tables 2 and 4 show analyses of various mill juices from several plants in Louisiana and Florida. It will be noted that in most cases the scale-forming constituents in the clarified juice are much greater than those present in the "ideal juice". Also note that the clarification process does not appreciably decrease the scale-forming materials.

Analyses of evaporator deposits from 11 mills in Louisiana are shown in Table 1 and from 2 mills in Florida in Table 3. In the case of the deposits from Louisiana it will be noted that they consist largely of silica, calcium

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phosphate and organic (loss on ignition). There is considerable variation with mills. The deposits from the mills in Florida are largely calcium sulfate and organic. Note in the case of Table 1 that analyses are given of "deposits after cleaning". It may rightly be inferred that in most cases evaporators are far from clean after the so-called boiling out procedure.

As there appears to be no obvious procedure for appreciably decreasing the scale-forming materials in sugar juices, research and development is being carried out in the writers' laboratory in an effort to determine whether treatment of the liquor in the evaporator bodies would be expected to decrease deposits. The first experiments were carried out with sugar liquors but these imposed such great problems that most of the work has been carried out with "synthetic liquors" based on data such as that in Tables 1 to 4.

The equipment essentially consists of a brass tube simulating an evaporator tube, enclosed in a glass container. The feed solution is introduced continuously into the feed supply vessel, from which the solution circulates to the heating section around the tube. When steam is generated in the tube, it passes off through a trap to a condenser. The water condensed is an indication or measure of the amount evaporated and is collected and measured. The general procedure is to make up the synthetic water under study and add it to the feed supply. The equipment is first adjusted with distilled water in the tube so that the evaporation rate is at a predetermined value, usually 25 cc. per minute (approximately 9.6 pounds per hour per square foot). Once this adjustment is complete, the feed supply water is allowed to replace the water evaporated. The solution becomes scale-forming and a deposit will form on the tube, decreasing the heat transfer rate and consequently the evaporation. The measured rate will therefore fall off. The rate at the end of 60 minutes is generally used as a measure of the scaling characteristics of the solution under test.

Pertinent data for four types of synthetic solutions used without treatment and using six different scale preventive combinations are given in Table 5.

It will be noted that with no treatment the rate of evaporation drops off and is quite low at the end of an hour for all four types of liquors. All of the "treatments" shown in the table improved evaporation rates; APA*M, EC;

Organic C and APA*ME being the most efficient. It should be noted that certain of the treatments are better for specific types of scale-forming materials than for others. For example, Organic C is very effective for $CaSO_4 \pm$ Oxalate; APA-ME is effective for $CaSO_4$, $CaSO_4 \pm$ Oxalate and $CaSO_4 \pm SiO_2$. The same is true of APA-M, EC but this material appears to have its chief application for $CaSO_4$ type liquors. These facts indicate that some consideration must be given to the type of problem involved in deciding which treatment may be expected to give the best results. As liquors vary from mill to mill, or for that matter in the same mill, one treatment cannot be expected to serve all purposes. In making a decision regarding the treatment to be used, analysis of the juices in different stages of processing and of deposits formed, are very helpful. An analysis procedure for juices has been published by Ulmer (1).

As mentioned owing to the "excessive amounts" of scale-forming materials in juice to the evaporators, "evaporator treatments" will not completely eliminate or prevent deposits; rather deposits are decreased and sometimes altered. Although some further development of "treatments" is possible it is thought that much of the improvement must come through decreasing the scale-forming constituents in the juice to be evaporated. In this respect more attention must first be given to analyses of juices. Recommended analyses to be made are shown in Tables 2 and 4. These should be carried out regularly in the plant. Undoubtedly it will be found that there will be some relation to clarification and the analyses of the juices. Following the mill operation in this manner should make possible regulating clarification so as to obtain a juice with less scale-forming materials. Also such analyses will make possible quickly evaluating certain changes in the clarification process. Once the clarified juice is improved, sugar evaporator treatments may be expected to give greatly improved results.

The analysis procedures used are rather simple to carry out. The tests for calcium, magnesium and total hardness are by simple titration; those for silica and phosphate are based on colorimetric procedures. All will be furnished upon request.

As mentioned work with the equipment mentioned has made possible an evaluation of scaling conditions in liquors similar to sugar juices. It has been possible to establish a mechanism for the action at least of treatments

referred to in this paper. It has been found that these treatments:

(1) increase the "apparent solubility" of the scale-forming materials. This decreases the amount of materials that precipitate in the evaporator and therefore the tendency for deposits to form.

(2) they coat or condition materials that do precipitate rendering them less adherent to metal surfaces.

Both steps have a tendency to decrease deposits. With a properly clarified juice excellent improvement is obtained through the use of such treatments. However as mentioned there are many improperly clarified juices and attention should be directed toward improving this situation.

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Table 1

Sugar Evaporator Deposit, Louisiana, 1950-51

Mill and Sample

	A	B	C						D	E				F			G	H	I	J	K
	*	**	1	2	3	4	1a	4a	4a	4	3a	4	4a	**	3	4	3	1	4	4	3
Carbonates	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	0.0	0.0	0.0	12.4	0.0	3.3	0.0	11.8
Silica	1.2	5.6	3.3	8.9	13.0	34.5	5.1	47.4	21.8	73.1	72.1	36.4	28.9	20.0	30.0	29.0	43.0	8.1	44.3	71.0	32.0
Sulfate	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T	T	T	T	0.0	3.0	0.0	0.2
Phosphate	6.2	32.4	31.7	27.9	23.5	5.3	35.6	9.9	11.0	0.1	0.8	0.7	1.3	7.0	16.0	17.0	1.2	33.1	0.2	0.0	3.9
Iron & Aluminum	17.0	1.6	T	1.1	T	T	1.5	0.9	8.2	0.7	3.6	T	T	4.0	T	T	2.6	3.5	4.1	1.0	6.5
Copper	1.6	T	0.0	T	0.0	0.0	T	0.0	0.0	0.0	T	0.0	T	T	T	T	0.9	T	T	0.0	0.9
Calcium	1.8	33.6	33.4	28.8	25.3	7.8	38.2	14.2	28.4	1.6	1.2	2.2	21.9	12.0	30.0	28.0	10.5	35.4	10.1	2.0	9.5
Magnesium	1.9	3.3	6.2	6.9	6.9	1.6	4.6	3.4	6.0	1.9	4.5	1.3	3.9	4.0	6.0	5.0	2.6	5.9	3.9	1.0	1.9
Chloroform Soluble	-	0.3	0.9	0.9	0.6	0.4	0.8	0.8	0.8	1.8	1.4	0.1	0.2	-	-	-	-	0.1	-	-	-
Oxalate	T	-	5.3	4.0	3.4	0.5	1.0	2.5	4.1	0.0	0.0	0.0	0.8	17.0	4.0	2.0	0.0	0.6	29.7	-	0.0
Loss on Ignition	22.0	22.2	18.4	20.8	27.0	49.2	12.1	20.9	18.8	20.3	14.8	59.0	33.6	36.0	11.0	15.0	12.3	13.0	36.2	25.0	30.5
Total		99.0	99.2	99.3	99.7	99.3	98.8	99.9	99.1	99.6	98.4	99.6	98.2					99.6			

* From coils from open pan evaporator. ** From heater.

Mills are coded by letters. Numbers refer to body or effect of evaporator. The letter a after the number means that sample was taken after cleaning or boiling out.

TABLE 2

Sugar Juices, Louisiana (1950-51)

	Crusher Juice Mill			Mixed Juice Mill			Clarified Juice Mill			Oliver Filtrate Mill	
	I	L	K	I	L	K	I	L	K	L	K
Calcium	1000	1160	1360	760	1620	1200	920	1200	1280	1620	1280
Magnesium	600	960	760	720	880	440	640	400	680	1580	760
Total Hardness	1600	2120	2120	1480	1500	1640	1560	1600	1960	3200	2040
Silica	160	300	100	160	180	60	280	220	180	280	240
Phosphate	600	600	600	400	360	400	0	60	60	30	240
Brix	17.30			13.50			14.34				

TABLE 3

Sugar Evaporator Deposits, Florida (1951)

	Mill A						Mill B Body 4 after Cleaning
	Quad. 1 Body		Quad. 2 Body		Body		
	3	4	3	4	3	4	
Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Silica	15.2	8.3	5.4	3.3	7.5	4.6	5.3
Sulfate	30.2	36.1	39.1	36.6	34.4	40.8	0.0
Phosphate	1.9	1.1	1.3	1.4	1.3	1.5	2.0
Iron & Aluminum	T	T	T	T	0.4	T	8.9
Copper	T	0.0	0.0	0.0	0.0	0.0	T
Calcium	26.6	25.3	29.0	30.2	26.9	25.9	53.0
Magnesium	4.0	2.0	2.9	4.0	2.7	3.3	3.4
Chloroform Soluble	0.4	0.0	0.2	0.1	0.1	0.2	0.1
Oxalate	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Loss on Ignition	21.0	27.0	21.9	24.1	25.6	23.2	16.1
Total	99.2	99.8	99.8	99.7	98.7	99.4	

TABLE 4

Mill A. Sugar Juices Florida (1951)

	Crusher	Mixed (Unlimed)	Mixed (Limed)	Clarified
Calcium	1000	1480	1200	2600
Magnesium	1400	1280	1400	1520
Total Hardness	2400	2760	2600	4120
Silica	120	120	120	320
Phosphate	240	200	160	0
Brix	14.5	12.5	14.5	14.0

TABLE 5

Results of Test Runs with Evaporator

Solution	Rate at Start	No Treat-ment	Disperser S; Starch Base	Rate after 60 minutes			Disperser ME; Ligno-Sulfonate Base	Jam Pectin
				APA-M, EC; Phospho-Alginate	Organic C; Processed Cellulose	APA-ME; Phospho-ligno-Sulfonate		
$CaSO_4$	25	12.3	15.9	23.8	20.8	24.1	22.0	20.4
$CaSO_4$ & Oxalate	25	6.8	10.8	15.0	24.8	24.3	18.0	19.6
$SaSO_4$ & SiO_2	25	13.1	21.4	21.2	22.2	23.1	23.2	--
Calcium Aconitate	25	15.5	15.8	15.6	15.4	16.1	15.7	--

Note: All evaporation rates are expressed as ml/min. In all, some 52 different materials or combinations have been tested. The results given are typical of those considered most applicable to cane sugar evaporator treatment.

CLARIFICATION OF FILTRATE BY CENTRIFUGING

by Charles C. Savois, Lula Plantation

The trend of present methods of manufacturing Raw Sugar is to simplify and at the same time utilize more scientific control. Manufacturers are installing more labor saving devices, and machinery that requires less maintenance, in order to cut down the cost of production to give the public a good product at low cost, and also realize a profit. Some of the scientific labor saving devices are automatic regulators for variable flow of juices, adding of lime to Raw Juice, level controls etc. One of the big labor, space and maintenance saving devices is the continuous mud filter. Most modern factories today have a filter of this type and some several, depending on the capacity of the individual mill and quality of its incoming cane.

Very often the change over, from old machinery to new types of machinery presents new problems. The one presented in this case is that brought on by the introduction of the continuous mud filter, which has replaced the old filter presses. The initial cost of filter presses are high, they are expensive to maintain and to operate, required a lot of space, but the juice coming from the old presses was clear and ready for the evaporators, that is, ready for processing into sugar. The continuous filter has simplified and cheapened this operation, but the juice coming from it is not very clear and requires further clarifying before it is ready for the evaporator. Therefore, the problem is how to clarify without recirculating and to keep the operation from being too costly. Before proceeding with a possible solution to this problem, I wish to mention that under good conditions, that is with good prevailing weather, clean cane and fresh cane, the cloudy juices leaving the continuous filter may be recirculated through the clarifying process with no apparent ill effect.

In the event of adverse weather conditions, or stale cane or a large amount of soil enters with cane, then bad clarification will prevail. The return of the dirty filtrate to the clarification cycle will seriously aggravate the condition and most probably cause the factory to slow down to

two-thirds or one-half grinding capacity. If the filtrate is ditched, the clarification will show a marked improvement. The difficulty in clarification is initially brought on by mechanical harvesting of sugar cane, which is a marked improvement in the field, but has introduced a problem to the processor.

Some grinding seasons we seldom have the above mentioned conditions, but normally, we always have some, and no matter if it is for just one or two weeks, if we have something that will keep us out of trouble at that time it is worth its weight in gold. When all conditions are good we can run very well without anything more than the continuous filter.

We all know that cane juice does not improve with age, and recirculating the filtrate thru the heaters and clarifier is equivalent to ageing it. Therefore, recirculating this juice is against all principles of good operation. Furthermore, the filtrate may be considered the oldest juice in the clarifier as it travels from the top to the very bottom and thru the process of filtering before being removed. If this filtrate can be run directly to the evaporators instead of being recirculated, it would definitely be an advantage to the process by keeping the fresh juice free from any old contaminated juice which may be drawn from the muds; that is by keeping the filtrate out of circulation, because this juice has already begun to invert.

Last crop a centrifuge was installed at Lula Factory and it proved itself in that it will do the job of keeping the factory operating at normal speed without ditching the filtrate; but, how much good it does when grinding conditions are good has yet to be proven.

The centrifuge was installed in an experimental fashion, and not permanently as it was our intention merely to determine if it could do the job. The experiment proved very favorable and it appears that the machine has very good possibilities. First, we piped the filtrate from both the high and low vacuum tanks directly to the machine thru open strainers that were fitted to the top of the centrifuge. The sludge coming from the machine was pumped back to the filter and the effluent was returned to the heaters. The machine ran this way for a maximum of three to four hours on the first series of trials. The machine had to be stopped after running this length of time, as it would get clogged with waxes from the cane muds. When this was realized as

the cause of the trouble, a simple heater was installed and the filtrate heated from 140° - 160°F to 180° - 200°F. The machine was cleaned and tried again and the wax trouble thus eliminated. The unit ran in this manner for a period of three days or more and the only thing that caused us to stop it was the improvising rig, especially the strainers, which at times would allow a piece of bagasse to get by and plug the nozzles.

At the time these experiments were being conducted, the weather conditions were very good and also the Clarification. The effluent was clear and bright, therefore, it was sent directly to the evaporators, and the sludge sent to the filter. During the last two weeks of grinding, the weather changed to warmer and rain. Some shippers had cane cut too far in advance of hauling to the mill and some began carrying a large excess of mud, so clarification soon began to get bad. The centrifuge had been stopped, as we had gone as far as we could, experimentally, under good weather conditions was started up again. The effluent was good so we sent it directly to the evaporators, the sludge we ditched for a while, as we are short of filter capacity, until the situation cleared up, which it did in about eight to twelve hours. The mill never stopped or slowed after the centrifuge was started. The machine had to be stopped after an eight to twelve hour run, because the excessive sand in the filtrate had cut the nozzles so badly that they had to be replaced with new ones which we did not have at the time. Three hours after the centrifuge had been stopped, the mill had to stop, because the clarifier had filled with mud and dirty juice. We ground at about half capacity, with a start and stop operation, for approximately eighteen hours before we could secure new nozzles. At about 2 p.m. the following afternoon the new nozzles arrived, and within a few minutes the machine was back on the line. The machine lasted about twelve or eighteen more hours before the nozzles were out again; but, during this time, the factory operated at nearly full capacity without any stops. Again, about three hours after the centrifuge was taken off the line, the factory had to stop for bad clarification. This ended our experiments with the centrifuge for the past crop, as it was impossible to secure more nozzles before finishing our season.

As a conclusion the writer will attempt to give some

figures that will more clearly give the results. The clarified juice is 85-90% of the total dilute juices coming from the mills. The sediment from the clarifier, or the feed to the filter, is the remaining 10-15% of the dilute juice volume. This feed to the filter contains lime salts, precipitated from the dilute juice by the liming operation, a considerable excess of lime, as well as shredded fiber from the cane plus a great deal of actual dirt and sand washed from the cane in the mills. The total sediment in this mud is generally in the neighborhood of 20% by volume, insoluble material.

The performations in the screen on the filter are in the neighborhood of .020" in diameter, therefore, it is not surprising that a considerable amount of the solids get by the filter. The combined filtrate generally runs from 2 to 12% total suspended solids, and this filtrate is considered the feed to the centrifuge. The feed to the centrifuge was 2100 g.p.h. maximum to 650 g.p.h. minimum, but the average maximum and minimum was 1800 g.p.h. and 1200 g.p.h. for a grinding rate of 2200 short tons of cane per twenty four hours. During adverse weather conditions, the filtrate coming from the filter was considerably less, which is opposite to the general line of thought, and the reason for this is that some less washing of the cake takes place with the intention of lessening the solids in the filtrate; but, the filtrate flow is lessened, mainly because the excessive sand and the general quality of the mud under these conditions cause the press cake to become more dense and compact on the filter screen thus allowing less water and juice to seep through and also causing the filter to pick up a thinner cake of mud.

With good weather conditions the feed to the centrifuge was, and remained, in the neighborhood of 1800 g.p.h. the percent solids by volume, 4%. The effluent 1450 g.p.h. with 3% solids and the sludge 350 g.p.h. 10% solids. In bad weather the feed dropped to 1500 g.p.h. with 12% solids, the effluent 1050 g.p.h. with .5% solids, and the sludge 450 g.p.h. with 39% solids. It was at this time that we ditched the sludge and it can readily be seen that the material ditched was a very thick mud.

In conclusion I can safely say that the centrifuge can clarify the continuous filter filtrate at a raw sugar factory containing 2-12% suspended solids at 1800 g.p.h. and 180°-200°F, producing an effluent containing .2%-.6% solids and a sludge containing up to 35% solids. At the lower solids the effluent is clean enough to serve as evaporator feed material. At levels of .4-.6% it may be recycled to the clarifier. In either

case the sludge can be recycled to the filter for further reduction in sucrose. For this coming season the De Laval Separator Company will furnish to Lula Factory with a new all stainless steel centrifuge, containing all the necessary improvements for resisting erosion, for further experiment and a possible conclusion to the idea.

The centrifuge is a continuous type with a number of cone discs placed one in the other spaced about one-thirty second of an inch apart, and set in a bowl. The bowl rotates at high speed causing the juice to travel between the discs where the solids are thrown out of suspension. The juice then rises through the center and the mud is thrown to the outer edge of the bowl and discharged through nozzles.

The centrifuge operates on the principle of difference in specific gravity of materials to be separated, the same as the clarifier, but the centrifuge increases the relative differences in specific gravities from 8,000 to 10,000 times. Also to further the speed of separation, the mud in the clarifier has to travel through the juices a distance of say twenty feet, in the centrifuge the mud has only to travel through the juices one thirty second of an inch. Multiply these relative differences by each other and one canreadilyrealize how and why the centrifuge can do this job so quickly and efficiently.

CLARIFICATION OF FILTRATES FROM VACUUM MUD FILTERS

By

Frank A. Vought

The year 1935 was the beginning of a series of important developments in mechanization of cane harvesting equipment. Mr. J. J. Munson, V.P. and Gen. Mgr. of the South Coast Corp. foresaw the necessity of reducing manhours required for cutting and loading cane and embarked on a program to accomplish this objective. Several attempts had been made to produce a mechanical cane harvester, some of which cut, cleaned and loaded cane in one operation. These were extremely cumbersome machines weighing from 25 to 30 tons and far too expensive for general use. It was decided to make the lightest machine possible for cutting only. With many improvements the present day Thomson "Hurry-Cane" Harvester is the result.

It was well calculated that with a mechanical harvester, not cleaning cane, would come many problems to the factory, and it was decided that a cane cleaner located at the factory, where weight was of no importance and power available, would be a necessity. Such a cleaner was designed, built and operated at Terrebonne Factory. This cleaner performed an excellent job of cleaning, but the capacity could not be extended beyond 70 tons per hour as designed; so auxiliary feeding was required. World War II came and this cleaner was abandoned due to shortage of labor for operation of the two feeding devices. Cane washing on the carrier and on feeder tables required no additional labor for operation and there was a swing to this method of cleaning cane. A third project undertaken along with mechanical cane cutters and cleaners was the so called "one-man" cane loader. Such a machine was built at Georgia Division of the South Coast Corp. and later improved by Thomson. The present Thomson loader

is the result of this effort.

These three major mechanization projects were essential to the survival of the industry. With the scarcity of labor during World War II and the years following, it would have been quite impossible to harvest the crops without improved mechanical harvesting equipment, and with the ever increasing wages crops would be harvested at a loss.

Along with these mechanical harvesting devices, as was well realized, came problems to the factory. During rainy spells, when great quantities of trash including field mud were brought to the factory with the cane, it was necessary to reduce the rate of grinding to approximately 50% of normal. Mills refused to take the normal feed with normal pressures and saturation. Clarifiers and filters were overloaded even at low rates of grinding and often mud was "ditched" in order to keep going at all. Multiple cross-grooving, larger circular grooving, and washing cane helped the milling problems.

Many years before the advent of mechanical harvesters, etc., continuous rotary vacuum mud filters had been accepted by the industry and many pressure filters. Rotary filters were economical in initial cost, cost of repairs, maintenance and operation. One man can operate the entire filter station, whereas old style filters require from three to five or more workmen. However, with the old style presses clear filtrate was obtained suitable for evaporation. The filtrate from the rotary filter is never suitable for evaporation and requires further clarification. The common practice was and is still to return the cloudy and cloudier filtrates to the main clarifier along with fresh raw juice. With clean, fresh cane and moderate rates of grinding or ample clarifier and filter capacity this procedure seems to offer little or no objection. With mechanically cut and loaded cane it is quite a different story, particularly during rainy weather. The manufacturers, or rather distributors of continuous filters have been urged to offer some means of eliminating the necessity of returning filtrates to clarification. Until the present time little if anything has been done and most factories continue to recirculate over and over the "fines" that pass through the screens. Most factories

have doubled or tripled clarifier and filter capacities, compared to the normal capacities required during dry weather. While this procedure has helped to permit higher grinding rates during wet weather than would otherwise be possible, it has also led to tremendous additional investments and enormous losses. It is not the purpose of this paper to present scientific data showing actual or theoretical losses due to recirculation, and inversion losses due to increased quantities of juice carried in process. It is felt this is a too well recognized fact to require elaboration. It will be assumed that it is agreed that the least juice possible in storage for good clarification, other factors being equal, causes a minimum of inversion losses, and that increased time in clarification beyond the minimum required is detrimental, rather than beneficial.

There are many factories operating very satisfactorily with 15 to 20 gal. clarifier capacity per ton cane per 24 hours when conditions are good, that is, with properly harvested cane and dry weather. Under these conditions press cake will run around 50 to 70 pounds (wet) per ton of cane with approximately 2% sucrose in cake making the sucrose loss in cake approximately 2 pounds per ton of cane. During rainy weather, without washing cane ahead of milling, press cake will run between 120 and 150 pounds per ton of cane. Under such conditions it is common practice to cut down on wash water on the filter or cut it off entirely and the cake will average around 6% sucrose; or sucrose loss per ton of cane will be approximately 8 pounds per ton of cane, an increase in filter cake loss of 6 pounds sucrose per ton of cane. In many cases the increased losses are considerably more, especially where mud is "ditched". Returning filtrate from filter to clarification is largely responsible for considerable of these and other losses. The fines that pass through the filter screen once will pass through repeatedly and being returned to clarification will rapidly increase in volume in clarifier, thereby reducing the space available for clarification and soon all the extra clarifier capacity provided for such emergency is occupied by a fine sludge that has been treated and returned to the clarifier. There are some factories using as much as 40 to 50 gal. clarifier capacity per ton of cane per 24 hours. The records will show that such

factories are still forced to reduce their grinding rates, their filter losses are many times increased and their boiling house efficiencies and yields are very abnormally low.

A more logical approach to the solution of taking care of excessive amounts of mud is first to remove as much mud from the cane as possible before it is milled. Proper washing on feeder tables where the mat of cane can be thinned to a depth of 18 to 24 inches, and adequate run-off of mud and wash water can be accomplished, appears to be the best method of removing the greater quantity of excess mud. After the mud remaining on the cane reaches the mill it will of necessity reach clarification. It is possible to remove considerable of the heavy sand and mud by settling or centrifuging; however, thus far nothing of note has been done along this line. Once the mud is removed from the clarifier it should not be returned. Returning filtrate from filters at best reduces the capacity of clarifier in the ratio of quantity of filtrate to incoming raw juice or approximately 10 to 20%. By not returning filtrate to clarifier, only the incoming raw juice need be handled by the clarifier. This fact alone would seem to have prompted more of us to seek ways and means of clarifying this filtrate so that it can be sent directly to evaporators. Since 1946 Westfield has used 7' diameter x 7' high settlers with 60° cone bottoms for clarifying filtrate. Four such tanks were used for batch treatment, adding, at first sweet water and lime, heating with open coil to cracking point, settling and decanting. Later two more tanks were installed. Addition of sweet water was for the purpose of aiding settling and to reduce losses in discarded bottoms. It was soon found that this filtrate settles rapidly without dilution. Later these six settlers were arranged in two parallel sets of three in series and equipped with continuous external heater with automatic temperature control-5' x 7' high cylinders concentric with outer shell, open at bottom and attached to cover were installed in clarifiers. Limed and heated filtrate enters between outside shell and inner cylinder, overflowing at top center. Third body discharges into evaporator charge tank.

The volume of three bodies is 7422 gals. or 21% of

the main clarifier. Cross-sectional area of three bodies is 115 sq.ft. or 7.35% of main 20' dia. 5 tray graver clarifier. Heater has 16-2'' x 20' copper tubes, one tube per pass, heating surface is 160 sq. ft.

Filtrate is pumped through heater at around 7' per second, returning a portion to the charge tank and sending an amount to the settlers equal to the quantity of filtrate flow from filter. By keeping velocity fairly high through heater it has remained clean. Due to the condition of filtrate it was thought that heaters would foul rapidly; however, it has been in limited service two seasons and has not required boiling out.

It was found when settlers were first used as presently arranged that the 3rd body tends to invert rapidly, second body less, and no inversion has been noted in first body. On one occasion settlers were operated parallel (using two sets of three each) continuously for four days. Purity at last body's had dropped about fifteen points and second bodies about six points. Purity of 1st bodies corresponded with incoming filtrate purity. All bodies were liquidated and again put in operation. After two days there was a decided drop in 3rd. Bodies (about 8 points) and 3 points in 2nd bodies. First bodies again showed no drop. It was decided to liquidate 2nd and 3rd bodies daily. First bodies show no inversion on continued operation and no inversion has been detected in 2nd and 3rd when liquidated daily.

The two sets of 3 bodies each are now operated intermittently each set being on one hour and off one hour. This seems to give the best results and allows mud to settle which is drawn off just before it is put back on. Approximately 55 gals. or 500 pounds of sludge are drawn from 1st body each hour. Second bodies have very little sludge and 3rd bodies are generally clear. Sucrose in sludge is approximately double that in the filter cake or approximately 6%, making hourly loss from sludge 30 pounds or 720 pounds per 24 hours or approximately 10% of the filter cake loss. If sludge were returned to the filter and could be properly filtered loss could be cut in half. Since this is a very small saving it is not considered worth the risk of trying to save.

By using these clarifiers we have been able to

operate during bad weather without reducing grinding rate. On one occasion these settlers could not be started when main settler began to foul due to excessive mud. It was about twelve hours before they could be started during which time mud level rose rapidly in clarifier and about half of the draw-offs had to shut off and grinding reduced to approximately 75% of normal. The filtrate clarifiers were then put in service. After about 3 1/2 hours mud cleared in main clarifier, filter cake improved, and normal grinding was resumed.

From Westfield's experience it appears that for a factory grinding 2400 tons cane per 24 hours the following equipment should be adequate:

1. One filtrate receiving tank 3' dia. x 5' high with 60° cone bottom.

2. One heater having 120 sq. ft. of H. S. with one 1 3/4'' tube per pass.

3. One heater pump with capacity of 60 to 80 gpm.

4. One 3'' automatic temperature control valve, operating on 6 to 8 pounds exhaust.

5. Two first body settlers 8' dia. x 6' high and 2 second body settlers 6' dia. x 6' high, all with 60° cone bottoms and with inner cylinders 1' less in diameter than outer shell.

The above to be operated intermittently as two sets of two bodies each. It is felt that with the above equipment there is maximum flexibility. Either set can be liquidated when necessary. Probably one set of the above proportion can be operated continuously for 6 to 12 hours and perhaps longer after which time the other set can be put in service and the 1st set liquidated. Inversion should be carefully watched. There is at least one factory installing two nine ft. dia. clarifiers this season. These are being arranged to operate parallel or in series and are being arranged to handle both the filtrate from the filters and mud from main clarifier. It will be interesting

to follow up their results.

Graver is working on a small clarifier, the Graverette, similar to their standard clarifier, but much smaller. It will be interesting to study what results they have. Due to the quality of filtrate, which seems to behave like sweetwater in the refinery, we feel that every precaution should be taken to prevent long periods in storage else inversion will be a major problem.

Between 1948 and 1951 De Laval and Sharples experimented extensively at Lula and at Westfield with various types of centrifuges. Mr. C. C. Savoie presented a paper before this society in 1950 giving some of the results at Lula factory using De Laval solid bowl centrifuge. At that time De Laval had hopes of making minor changes in their valve arrangement and obtaining a satisfactory machine. Some changes were made and tried out at Westfield, in 1951 with little if any success. These followed a series of experimenting at Westfield by Sharples. At Westfield it was possible to observe the work of centrifuges compared to the settlers which up to that time were operated by batch treatment. There were no times that any of the centrifuges approximated the results of the settlers.

Some experimenting has been done with modifications of the Williamson and Jacobs liquor clarifiers, using air as a means of floating impurities in a blanket at the top which could be skimmed off. Fines consist largely of silt and sand, most of which is too heavy to be removed by floatation. Clewiston, Florida is using some equipment this season for removing mud from juice ahead of clarification. The results are not available at this time.

We believe sufficient interest is finally being taken in this all important subject, that by the end of the coming grinding season there should be available a great deal of interesting data. This paper is designed only to offer suggestions and promote interest along these lines.

We feel it should be followed up energetically this coming season. It is suggested that some of the younger members be appointed at this time to begin promptly to study the subject thoroughly with the idea of presenting intelligent data and actual results after the coming grinding season.

FILTER PRESS FILTRATION OF CANE MUDS

By

H. J. Jacobs, Georgia Refinery, South Coast Corp.

During the eight grinding seasons in which the Oliver Filter, 8' x 16', was operated at Georgia Refinery the following conditions were observed:

1. It was always necessary to return the entire filtrate, both "Clear" and "Cloudy", to the Dorr Clarifier.

2. Following a rain, when an excessive amount of mud was brought in with the cane, the grinding rate was greatly reduced due to reduction of clarifier capacity. This condition was alleviated whenever necessary by operating four center feed filter presses, sending the filtrate directly to the evaporator.

3. Clarification difficulties, caused by old cane, trash, sour cane, etc., appeared to be aggravated by recirculation of the Oliver filtrate.

4. The sucrose loss in filter cake was excessive, particularly in the wet seasons.

These observations raised the question: "Which is more economical operation, for us, the Oliver Filter or Filter presses?" A comparison of the "Sucrose losses in Filter Cake % Cane" obtained from filter press operation, with the losses obtained from Oliver Filter operation, as shown in Table I, indicate that a study of filter press operation under present conditions was warranted, since each 0.100 Sucrose % Cane lost in filter cake

represents a loss in recovery of about 1.75 lbs. 96° sugar. See Table II.

In addition to the possible savings by reduction of Sucrose loss in filter cake, we could expect the filter press operation to effect an increase in Dorr clarifier capacity, since the filtered juice would be sent directly to the evaporator. And, of course, the elimination of recirculation of impurities in any stage of the process is always desirable.

We decided therefore to try filtering the total cane muds during the 1953 grinding season with filter presses.

We had available six Shriver center feet 36'' x 36'' presses which we could use for this purpose. Four of these presses were already connected as part of the mud handling system, the other two were arranged so that they could be used when needed.

The operation was started with four filter presses, which were ample until Oct. 26th, when we had our first rain. We operated six presses for three and one half days, then went back to four. It rained again on the third and fourth of November, and it was necessary to operate the six presses. This pattern of operation repeated itself with the rainy and dry spells of weather, and the statement can be made that with normally clean cane only four presses were necessary but all six were needed for dirty cane.

The filters were dressed with 3 x 3 ply yarn, weight 21 ounces per square yard. No precoat was used, nor was any filter medium used during the filter cycle.

The mud from the Dorr was pumped with the Dorr diaphragm pumps into a tank; a low level was maintained in the tank, and there was no agitation or reheating. A small stream of hot water and lime suspension were flowed into the tank, the dilution of mud and pH being controlled by the operator and supervisor. It was attempted to maintain a pH of from 8.0 - 8.0. From this supply tank, to which also was run any dirty juice from the presses (from broken cloths, or leaks), the mud was pumped thru the filter presses by an Oil Well Mud Hog Imperial, Duplex pump, size 10'' x 5 7/8'', with a pressure governor set at 40 p.s.i. so that the pressure on the filter presses could not exceed 40 p.s.i.

In starting a press, the charge valve was opened

gradually and the build up of pressure was controlled and gradual. By careful operation the very first juice was clean and went directly to the evaporator. The filtered juice was received in a two compartment trough, the clear juice flowing thru one compartment, and any dirty juice, as from a broken cloth, was directed to the other compartment from which it flowed to the mud supply tank.

For the entire operation there were a total of 3747 filter cycles. The presses were dressed with clean cloths a total of 134 times, which includes the original dressing. This means that we were able to obtain 28 filter cycles from each dressing. When a press was dressed, the dirty cloths were washed in an American Ideal Style "A" washer. The cloths were dried, inspected when dry, and those cloths needing repair were repaired by an employee on a contract basis.

The operating crew consisted of one operator and two press cutters per shift. When presses needed to be dressed, the two shift press cutters would work overtime for the dressing operation. One man, working eight hours in the day, took care of the cloth washing, drying, and handling to and from the repair room. The total labor for the crop, including the cloth washer, was 7586 man hours, or 0.059 man hrs. per tons cane.

Operating Costs

Item	Total	Per ton cane
Labor	$6068.80	$0.04721
Material		
New Cloths	2368.83	0.01843
Cloth Repair	288.48	0.00224
Total	$8726.11	$0.06788

We used some second hand cloths, accumulated from our refining operations, and this reduced our new cloth cost. However, we had on hand at the end of the season 512 cloths suitable for reuse next season, which we estimate to have about the same value as the second hand cloths we started with.

Significant data of the operation is shown in Table III.

Under our operating conditions at Georgia the filter press operation is very profitable. With 19.61'' rainfall we could expect from Oliver Filter Operation, according to previous experience, sucrose loss in filter cake to be 0.378% cane. The excess loss over filter press cake would be 0.202% cane, which represents 3.59 pounds of 96^{o} sugar per ton of cane, worth, at 6 cts/lb., $0.2154.

We readily admit that the Georgia experience with Oliver Filters has been very poor compared to general experience throughout the sugar industry; that even in Louisiana a few factories with high ratios of juice clarifier capacity and filter area have, by means of compound clarification, obtained very good results. But, that there have been many operators in Louisiana obtaining poor results is evidenced by the interest shown in the past few years in means of improving the mud filtration operation. It is hoped that the information given by this report will be of some help to those who are looking for such improvement.

TABLE I

Crop	Filter Operation	Rainfall Inches	Sucrose Loss In Filter Cake	Remarks
1937	Filter Presses	16.58	0.130	
1938	Filter Presses	8.13	0.134	Sour Cane
1939	Filter Presses	10.92	0.135	
1940	Filter Presses	7.08	0.177	Sour Cane
1941	Filter Presses	7.39	0.112	
1942	Filter Presses	8.43	0.148	
1943	Filter Presses	12.53	0.145	Sour Cane
1944	Filter Presses	17.22	0.137	
Average		11.035	0.13975	
1945	Oliver Filter	10.60	0.165	
1946	Oliver Filter	6.84	0.276	Sour Cane
1947	Oliver Filter	21.45	0.391	
1948	Oliver Filter	17.22	0.363	
1949	Oliver Filter	7.34	0.222	
1950	Oliver Filter	9.21	0.204	Sour Cane
1951	Oliver Filter	5.71	0.210	Sour Cane
1952	Oliver Filter	3.19	0.185	
Average		10.195	0.2520	

TABLE II

Value in pounds 96° sugar/ton cane, at 97 BHE, represented by 0.100 sucrose % cane, for juice purity range from 72 to 80
(Winter & Carp Formula)

Juice Purity	Per Cent Retention	Lbs. 96° sugar/t. cane
72	85.318	1.706
73	86.096	1.722
74	86.844	1.737
75	87.571	1.751
76	88.279	1.766
77	88.966	1.779
78	89.643	1.793
79	90.299	1.806
80	90.936	1.819

TABLE III

Data of Filter Press Operation 1953 Crop

Run #	Cane Ground Gross Tons	Rain Fall Ins.	Lbs. Filter Cake/ Press Cycle	Lbs. Filter Cake/ Ton Cane	% Sucrose Filter Cake	Suc. in Filter Cake % Cane	Purity Defi-cated Juice	Purity Filter Press Juice
1	17,879	0.0	2273	47.83	5.56	0.133	77.09	
2	22,800	0.38	2351	57.94	5.64	0.164	78.52	76.76
3	24,652	1.19	2317	62.12	5.67	0.176	79.82	78.10
4	25,714	8.97	2581	76.18	4.91	0.187	80.90	79.68
5	14,739	6.62	2693	95.72	4.06	0.194	82.40	80.60
6	22,759	2.45	2547	97.27	4.05	0.197	83.05	81.27
Avg.	128,543	19.61	2477	72.21	4.86	0.176	80.50	78.88

Note:
Light Load = 1920#
Heavy Load = 3216#

TESTING OF CANE FOR SUCROSE AND TRASH

by Leon F. Desroches & Thomas Lowe

Testing of cane for sucrose has been the general practice in Louisiana factories for quite a long time, but testing for trash has only been in general practice since 1948.

When we consider the fact that the average factory grinds 100,000 tons of cane a season and that the cane, with benefit payments and molasses bonus, is worth between $9.00 and $10.00 a ton, it is readily seen that close to one million dollars is involved on the average, and twice this amount in the case of our largest factories, which means that the sampling and testing must be done as fairly and accurately as possible.

To find out how the various factories handled this problem, a survey was made of twelve factories on Bayou LaFourche and the Mississippi River. Lack of time and the distance involved made it impossible to cover the entire sugar district, but it is felt that the twelve factories sampled give a fairly accurate cross-section of the industry.

Twenty-five or thirty years ago, nearly all sucrose tests were made on crusher juice as the cane was actually going through the mill. The advent of trucks, and the fact that several shippers loaded cane together, made it impossible to use the crusher juice sample for all shippers, and for this reason, small test mills were introduced as far back as thirty years ago. However, much cane was still tested on crusher juice samples up to the time that mechanical harvesters came into general use. With the harvesters came mud and trash, and shortly thereafter, it became necessary to start washing the cane on the carrier in bad weather, and this ruled out the possibility of using the crusher juice for sucrose tests. This wasunfortunateas it was definitely a step backward in accuracy when it became necessary to use the small mills for all the sucrose tests. Of the factories surveyed, eleven used small test mills, and only one factory was fortunate enough to still be able to use the crusher juice for the sucrose samples. Naturally, this factory does not wash the cane on the carrier as is the practice of seven of the factories out of the twelve that were contacted.

In the majority of cases, the sample taken for sucrose is composited and ground once or twice a day. On an average, a sucrose sample was taken for about every twenty-five tons of cane, except in the case of very small shippers.

The question of test mills is interesting. Of the twelve mills contacted, six had three roll test mills without hydraulic pressure on the top roll, four had three roll mills with hydraulic pressure, and two had six roll mills with hydraulic pressure. The use of hydraulic pressure on the test mills is certainly to be recommended, and it would seem that a six roll test mill would be better than one of three rolls. It would be helpful if some of the sugar machinery builders would design a small mill with hydraulic pressure, especially for cane testing, as most of the mills in use were built for grinding cane to make syrup, and are much too light to carry the heavy pressure that a good test mill should carry.

Every chemist and manager in Louisiana has had his worries over factors to be used to convert the test mill analyses to factory normal juice. It is true that the factors are adjusted at short intervals so that the analysis of cane bought corresponds to that shown by the factory normal juice, but the variations in the factors are considerable, and at times the factors work out to be obviously on the low side and again the other way. It is reasonable to suppose that a good test mill with hydraulic pressure would eliminate some of the wide variations in factors, but there is not sufficient evidence at present to confirm this. It is pretty well established that the sucrose factor is higher in years of high sucrose and low in years when the cane is green and low in sucrose. An average of the factors used in the 1950 crop by the twelve factories covered by this survey shows that the average maximum sucrose factor was 0.903, the average minimum was 0.845 and the general average was 0.874. The Brix factors did not seem to very quite as much as the sucrose factors, being: 0.963 maximum, 0.914 minimum and 0.939 average. It should be explained that the maximum and minimum figures are the average for all twelve factories, and that in a few extreme cases the figures were outside the limits shown, but as a general rule, the factors used by the various factories showed a remarkable amount of agreement.

The sampling of cane for trash still has quite a few problems. This is due to many factors, not the least of

which are the various methods of transport, and the fact that the trash itself may be dry cane shucks weighing 15 pounds per cubic foot, or field soil weighing 100 pounds per cubic foot.

The usual procedure at most of the factories is to take truck samples from the feed table as the cane is being unloaded. Factories that grind cane from standard guage cars cannot take the trash sample until the car is ground, and the sample in this case is best taken when the car is about half empty. Barge cane offers its problems also, but fortunately, the amount of cane transported by barges now is relatively small. Cane delivered in narrow guage cars is usually sampled after the contents of the car have been raked into the carrier and this is a definite advantage in favor of the shipper, as much of the heavy trash falls to the bottom of the carrier where it cannot be sampled. In the case of several shippers loading at the same hoist, the cane for each shipper must be segregated by truck loads, or the bundles tagged for identification at the factory.

The number of samples taken for trash by the various factories varies considerably. The smaller factories take a trash sample from each 15 to 20 tons, some of the larger factories sample for trash on each 40 to 50 tons. The size of the trash sample varies from a minimum of 30 lbs. to a maximum of 150 lbs. with the average size of the trash sample being about 60 lbs. A two-man stretcher made of galvanized iron or old filter press cloths is used almost universally and seems the best method of transporting the sample. The trash is removed from the sample by hand in all cases. In ten cases out of twelve, the trash analysis was made as soon as the sample was taken, and only two of the factories reported making a composite sample for trash. This is just about the exact opposite of the procedure followed with the sucrose samples.

From the limited amount of information obtained, it appears that all the factories are making an effort to sample and analyze properly for trash and sucrose. The problem, especially as regards the test for trash is complex, and no doubt, subject to improvement. It would seem that the best means of improving the trash test and reducing the inherent error would be to take as many samples per day from every shipper as is economically

possible, and to use a high class of personnel in taking and analyzing the samples.

In conclusion we wish to thank the managers and other personnel at the various factories for their cooperation in furnishing records and data which made this paper possible.

STOKER FIRED BAGASSE FURNACES

by Frank Mallen

Bagasse burning as it has been carried out for some years back in furnaces of careful design, has more or less had the advantages of stoker fired furnaces in that:

(1) The fuel or bagasse was at a steady and somewhat easily controllable rate.

(2) With a continuous and more or less steady rate of fuel, a proper distribution of air supply has been possible.

(3) Combustion results have been good and obtainable with fair minimums of excess air, thus leading to good combustion and efficiencies, at least, over periods where furnaces and after combustion-chambers were fairly clean of ash.

However, the furnaces so far used have been backward in their inability to in a more efficient manner handle the ash problem, which to a varying extent with types of furnaces and settings as a whole, contributes to the lowering of over-all efficiencies and avilability.

In so far as the author can recall, possibly the late G. P. Ward, then connected with Babcock & Wilcox Boiler Company, was the first to in a practical way improve on the deficiency, when he introduced around the middle twenties, his Single Pass Ward Furnace for burning bagasse. There may still be some question as to the efficiency of the furnace as compared to other designs, but there can hardly be any question that the idea did lead to more economical and improved operations, and to units of much greater availability.

Bagasse furnaces have been of all sorts of designs with regular stationary grates; inclined or step grates; reflection heat arches; fancy and elaborate passes and after-combustion chambers, etc., but the majority of the furnaces have played around the basic use of the horse-shoe hearth

with tuyeres, which Ward retained and combined under the boiler unit.

The idea of mechanical spreader firing dates back some 130 years and the most effective development period of this type of stoker in this country can no doubt be traced to around the years 1925 to 1929, when more efficient feeding and distributing mechanisms were combined with forced draft high resistance grates. Because of the outstanding characteristic of this type of stoker to satisfactorily burn a wide range of fuels, selection of spreader stokers in the last few years, as compared to other stokers has been remarkably great.

Present day milling practice gives a bagasse of quite uniform size and with a fair percentage of bagacillo and fines which are ideal for suspension burning, and a feature of the spreader type stoker. In view of the success of spreader stokers with such wide variety of fuels, and the apparent ideal preparation of bagasse as a suitable fuel without the need of special accessories for sizing as is required for many coals, Combustion Engineering & Superheater, Inc., decided to adapt their spreader stoker for burning bagasse, and the first installation was supplied by this firm for one of the largest mills on the Island of Cuba, for operation in the year, 1948.

Before the regular installation was made, a unit stoker was supplied for a trial under an HRT boiler. The trial not only confirmed to the satisfaction of all that the spreader feature was practical and feasible, but most important of all, it led to the development of a proper and suitable bagasse feeder, without which the spreader stoker installation would not have operated satisfactorily. The original feeder ideas had to be discarded and the new feeder was developed in time.

The installation in the year 1948 consisted of a new VUZ type boiler of around 12,000 sq. ft. heating surface; water tube side and top furnace walls; superheater for 520°F total temperature at 165 P. S. I. pressure; air pre-heater of the tubular type; induced and forced draft fans. The boiler was fired by four spreader stoker units, each unit with grates 9 ft. length with two section dump feature, and the four units accounting for an over-all grate width of 18 ft. Over fire and furnace mix-jets were provided as well as a cinder or fly-ash system from last pass of boiler, which continuously returned to the furnace, for the recovery of any combustible in the gas dust and at the same time serve as mixing over fire jets.

Two bagasse feeders served the four stoker units of the

boiler, each feeder supplying two units, and both feeders operated by a combined single drive and variable speed reducer. A Hagan combustion and steam supply rate automatic control was provided which would have made possible automatic operation at any point within the boiler range, by merely setting the load desired, but conditions at the mill, and particularly so at the time this unit was installed, did not warrant such operation, and the automatic control feature was not used. It was evident however, that the feature was entirely feasible and practical, if operations required it.

The boiler proper was provided with chart record meters and instruments for the following:

(a) Steam flow output
(b) Steam pressure and temperature
(c) Flue gas temperature at boiler outlet
(d) Flue gas temperature to stack
(e) Temperature of pre-heated combustion air
(f) CO_2 in flue gas

Large scale Hays draft indicators were provided for the following:

(a) blast under grates
(b) furnace draft
(c) boiler outlet draft
(d) draft differential between furnace and boiler outlet
(e) draft at air-heater gas outlet or inlet to induced draft fan.

As a whole the boiler unit was well equipped with instrumen and at any instant one could tell exactly just what the unit was dc ing, not only as to output, but the efficiency of the output as well and this was most helpful at the time, as quick and definite changes could be made for best operation, and the records and indications were convincing evidence of the satisfactory performance of the new unit.

For this installation, where the burning of bagasse was an entirely new procedure, naturally some minor difficulties and changes were evident at the start All were quickly overcome and the unit operated very satisfactorily to the end of the crop at 100% availability. The bagasse spread well over

the grates and no noticeable decrease in steam output could be observed in the steam charts during dumping of grates or removable of ash from ash-pit.

It was found in burning bagasse that the characteristics of the gas dust was quite different from that of coals, and it was necessary to consider complete changes in the cinder recovery system.

There is under present milling practice a good percentage of bagacillo and fines which must burn in suspension. The density of these fines vary considerably from those of other fuels, and it is just possible that any future modifications for refined improvements in burning bagasse in the spreader furnaces, may be along the lines of increased furnace area for lower vertical gas velocities, and possibly a longer gas travel thus increasing furnace volume.

Unquestionably, the spreader stoker method for bagasse firing has made an excellent entry into the field, and will no doubt continue to have favorable acceptance by mills requiring good over-all efficiencies of operation.

It might be pointed out, that the bagasse feeder used by C.E. & S., Inc., allows for variable feed rates within predetermined limits. The desired feed rates can be manually controlled, or the device can be used with an automatic combustible control, as do modern units burning other fuels. In operating the feeder manually for the desired rate, the device imposes constant and uniform ideal test working conditions, which with minimum effort and skill, allows for the proper and best proportioning of combustion air, and the uniform operating conditions must achieve best combustion and efficiency results.

Under proper comparable conditions of operation, it is doubtful that noticeable gains of efficiency of combustion can be claimed for the stoker firing over a well designed Ward hearth or even perhaps other types of furnaces in use. However, with a constant bagasse supply the spreader stoker fired furnace will operate at the desired capacity, for an indefinite period at maximum and constant efficiency, without noticeable effects during grate cleaning periods. On the other hand, the capacity output of other furnaces is reduced during cleaning periods, and in many cases the combustion results will drop-off or tend to lower, from a clean furnace condition to the cleaning point. The extent of capacity reductions will vary with installations.

The author had occasion to effectively observe and compare two units of equal heating surfaces and with equivalent accessories, and both provided with full set of operating and guide instruments as described for the 1948 spreader installation. One of these two boilers was the one of the 1948 installation described, and the other was also a new installation of the same year but consisting of a 4-drum boiler served by a 3-hearth furnace. Combustion efficiency results as well as output capacities compared favorably for the two units, but it was definitely established that the output capacity of the hearth fired unit over the 24 hour period was lower, because of the reductions effected during the three cleaning periods. Surprisingly, output and combustion efficiency sustained quite uniformly good without a drop-off, except for the cleaning periods. This particular set-up and comparison, figured to an over-all 90 to 94% available capacity for the hearth unit, as compared to 100% with the spreader unit. Contrasts of costs of labor for ash cleaning and removal for the two units were astounding.

During the last crop in Louisiana, trials were made at three mills of burning bagasse by what may be tentatively termed Air Spreader Stokers. The set-ups are indeed simple and if a uniform spread of bagasse, over proper grates, in adequately proportioned furnaces can be accomplished, the firing of bagasse with this type of bagasse throw or spread, would also be a success.

A suitable bagasse feeder before the air-spread device, would without a doubt make a great improvement, but it still appears that a great deal of experimenting and changes may be necessary with these air-spread devices to accomplish a uniform coverage of grates, which is a requisite for the proper burning of the fuel.

Of the installations made, possibly the two boilers at the mill which has definitely taken out the grates and throw-devices, had the chance of showing up the best results, with proper spreader units, because the proportions of the furnace were good for low vertical gas velocities and offered maximum leeway in placing of over-fire or furnace mixing jets. Also the vertical gas travel to heating surface was more than ample, and with proper firing it might have resulted in a minimum of gas dust through boiler and to stack.

At Helvetia, a used boiler was installed in a new

setting, and the furnace area and volume is apparently well proportioned for a spreader grate fire.

At Cinclare, the settings of the smaller boilers were altered, by moving out the front walls some three to four feet, but even with this change, the furnace proportions are not as good as the one at Helvetia.

The idea of the air-spread device, due to its simplicity, is indeed enticing, but it still requires a great deal of experimental work for it to uniformly spread fuel over entire grates, if it is to approximate in any way the results of the mechanical revolving drum-paddle thrower.

Even with the more or less limited and somewhat unfavorable experiences had with these grate fired furnaces during the last crop in Louisiana, apparently, the ease of ash cleaning has made an impressive point. Assuming that some worth while improvements can be made on the air-spread device during the next crop, it will be interesting to follow and observe any improvement in results, particularly at the Helvetia mill, which has the most favorable furnace proportions of the units now installed.

PROCEEDINGS

American Society of Sugar Cane Technologists

1950-57
Volume 5

January, 1957

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FOREWORD

This is the fifth volume of proceedings of the Society which have been published since its founding in 1938.

The first volume published in 1941 included papers presented during 1938, 1939 and 1940. Mr. Walter Godchaux, Jr., the then Secretary-Treasurer edited that edition.

The second volume published in 1946 included papers presented during the period 1941-1945 inclusive. Dr. E. V. Abbott, Secretary-Treasurer, edited that volume.

The third volume published in 1953 included papers presented during 1946-1950 inclusive. The fourth volume included papers presented during 1951, 1952 and 1953. This the fifth volume includes papers presented during 1954 and 1955. The last three volumes including the present one were edited by the writer.

ARTHUR G. KELLER

SECRETARY-TREASURER

January 1957

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HOT AIR TREATMENT OF SUGARCANE IN AN EFFORT TO CONTROL STUNTING DISEASE

By Lloyd L. Lauden, Agronomist and Field Representative, American Sugarcane League and Leon Nugent, Operator of Unit for American Sugarcane League.

The report, "The Occurrence of a Hitherto Unrecognized Growth-Retarding Disease of Sugarcane in Louisiana" by Dr. E. V. Abbott of the USDA Sugar Station, Houma, La., gave an account of a new disease which was spreading very rapidly throughout the cane fields of Louisiana. Because of the concern this report created within the Louisiana sugar industry Mr. Stephen C. Munson, Chairman of the Contact Committee of the American Sugar Cane League, appointed a committee composed S. J. P. Chilton, Louis Arceneau, Elliott Jones and Lloyd L. Lauden to study the control of this disease.

This committee, after considering the data from Australia and the limited amount of material Louisiana State University and the Houma Station were able to obtain in the period January through August, 1953, recommended that the League set aside a sum not to exceed $5,000 to be used in the construction and operation of a mobile hot air treating unit. This committee decided in favor of the hot air treatment over the hot water treatment after germination tests in August indicated that better results were obtained with hot air treatments of 129°F for 8 hours than with treatments using hot water at either 125°F for 1 1/2 hours or 122°F for 2 hours. The plantations chosen by this committee were Secondary Increase Stations already in the cane increase program and well distributed geographically over the sugar cane area. The varieties selected for treatment were CP36-105, CP44-101, CP34-120, CP36-13, CP43-47, CP29-320, CP44-155, and Co-290.

After considering the selection of a unit, a La Cross trailer with a 5 ton White power unit with a bed 9 feet wide and 26 feet long owned by the Louisiana State Agricultural Engineering Department was used. A chamber 9 feet wide, 26 feet long and 8 feet tall was built and secured to this trailer bed. This chamber was constructed of 1/4 inch plywood and covered with 55# roll roofing paper. A Doherty crop dryer supplied the heat. This dryer is powered by a 20 horse power V-4 Wisconsin engine with a propeller blower assembled directly to the crank shaft. The capacity of this dryer is 1,000,000 BTU of heat and an air flow of 30,000 CFM against a 3/4" static. This dryer was mounted on the apron of the trailer. Temperatures were observed in the cane with a Tagg-Heppenstal potentiometer. A recording thermometer was used to indicate the air temperature inside the chamber.

The League engaged Mr. Leon Nugent, a graduate of Louisiana State University, to operate this unit.

An attempt to control the distribution of heat when the chamber was solidly packed with cane failed even though the heat entered the bottom and was exhausted from the top. A central ceiling duct containing 6 variable size outlets was ultimately constructed and exhaust ports were cut into the flooring. Removable shelves were then installed to allow good circulation of heat. Large loading doors were constructed on one side of the chamber. All cane treated was hand loaded into the chamber. Approximately two hours were required to load the average treatment of 4.5 tons when four to six workers were used. Unloading time averaged one and one-half hours when the same number of workers were used.

Successful operation largely depended upon the manner in which the cane was placed on the shelves inside the chamber. Best distribution of heat resulted when the cane was stacked so as to leave an air space between the shelves. It was necessary to pack the cane tightly against the walls both on the sides and the ends. This discouraged the tendency of the air to channel the walls. Experience proved that a heavy layer of cane on the floor of the chamber resulted in better distribution of heat. The first shelf in the rear end of the truck proved unnecessary and was removed. The cane here was stacked tightly to about four inches of the second shelf.

Trials placing thermocouples at various places within the chamber indicated that the top of the chamber became hot first and remained the hottest. The bottom or the floor layer was next to become hot and remained somewhat below the temperature of the top layer. The center layer for the entire length of the chamber was last to become hot and was the most difficult to maintain at the required temperature. For most treatments seven thermocouples were used.

Three thermocouples were placed in three canes in the top layer, one in the forward end, one in the center section, and one in the rear of the chamber. Three other thermocouples were placed in the center layer one forward, one center, and one in the rear of the chamber. The other thermocouple measured the temperature immediately below the air duct. Temperatures were observed and recorded at 15 minute intervals in all treatments.

In several treatments the desired temperature in one or more sections of the chamber was never reached. This cane, however, has been planted and will be observed. The air temperature inside the chamber always reached at least 129°F, and in some instances went far above 129°F.

Three factors which affected the time required for the canes to reach 129°F were the size of the cane, the amount of leaves on the cane, and the climatic conditions. Clean, small barreled canes treated on warm sunny days resulted in good treatments. Cloudy, cold, or rainy days were not conducive to good treatments regardless of the size of

the cane.

Unfortunately this unit was not completed and ready for use until near the beginning of grinding and at that time many places originally selected were extremely busy with harvesting operations. The strike also prevented the treatment of cane at several places. Because the Western area was not affected by the strike more cane was treated there. In spite of a late start and the strike difficulties, approximately 131 tons of cane were treated.

Below are the places visited and the varieties tested.

	Varieties Treated					
Plantations	34-120	36-13	36-105	44-101	44-155	Co290
	Tons					
Smithfield*			10.0	10.0		
St. James Co-op.			4.0	4.5		
Glenwood				4.5		
Clovelly Farms	9.0					
Oaklawn		4.0	4.5	4.5	4.5	4.5
Orange Grove (Iberia)			11.0	20.0	2.0	
Landry (Iberia)				5.0		
Enterprise Plantation			6.0	9.0		
Godchaux (Raceland)				13.5		
Totals	9.0	4.0	35.5	71.0	6.5	4.5

*Cane treated in solid mass, some sections temperatures reached 180°F; other sections termperàtures reached only 79°F. This cane is considered of no value.

Better distribution of heat could be brought about with this unit by insulating the chamber. There is also the possibility that the installation of deflectors at the openings in the ducts could assist in better distribution of heat.

Treated canes have been dug up for observation to determine the extent germination was impaired. The eyes on most material observed seemed to be sound and shoots were beginning to appear by January 5, 1954. Most of the treated material was planted rather late, and, in some cases, in extremely dry soil.

It is too early to draw any conclusions from this experiment at this time. It is hoped, however, that the material treated will come up to a good stand and be free of the Stunting Disease.

WHY PIECE WORK?

By R. J. LeBlanc--Godchaux Sugars, Inc., Raceland, Louisiana

There has been quite a bit of interest evidenced lately regarding the piece rate system we have established in connection with our field workers and at the request of Mr. Richard McCarthy, Jr., Chairman of the Society's Agricultural Section, I have prepared a paper on this subject to be presented to you today.

This system was first instituted in our field operations two years ago..during the planting of the 1952 crop. We also carried it over into our 1952 harvesting operations on a modified basis in connection with crossing cane and salvaging or cleaning behind the harvesting machines. It was the result of studies we made in an effort to encourage labor to remain on our farms, for as you all know, during the past several years field labor has been moving away from farms in increasing numbers into local industries.

We felt that the establishment of such a system would not only provide an incentive for our laborers to accomplish more.. and be compensated accordingly..during their nine hour day's work, but at the same time it would also allow us to complete our required work schedules with the fewer people living on the farm.

The results of the piece work rates on planting cane and the modified piece work rates in our harvesting operations for the 1952 crop appeared to us to be successful enough so that for the 1953 season we established piece work rates for all of our planting and harvesting operations.

It should be clearly understood that "piece work" is quite different from "task work", which latter system is also used extensively in sugar cane operations. On a "piece work" basis, a worker must put in a full day's work and if he accomplishes more than the established requirements for a day's work, he is paid extra wages above his regular day's pay for the additional amount of work accomplished during that work day. Under task work rates, a worker is given a certain amount of work to perform, after which his day's work is done except that the task should be such that the worker must accomplish it at least within the work day.

In our experience, we found during the past two years that the number of workers required when piece work is used is considerably less than the labor requirements for a day or "task work" basis. Because our laborers work nine hours a day and that under our piece work system they are given an incentive by which they can earn extra

pay if more than a regular day's work is accomplished, we have been able to reduce our labor requirements both for planting and harvesting operations. I might add that we have found a very favorable attitude existing among our laborers who have been getting higher wages commensurate with their production or performance record. We are planning to use this same system again this year, improving it where ever possible.

In operating our planting schedule on the piece work basis, the key to the amount of planting done by any set or crew is the actual number of men riding the carts for the purpose of throwing out the cane and those who fix the cane in the row. Past experience shows that one acre planted per day per man in this key group is a reasonable rate and this has been established as the piece work basis. Following is a hypothetical case showing the actual operation of this piece rate based on a combined group operation consisting of several plantations, where 800 to 1,000 acres of cane planting are involved and where five sets or crews planting two rows each are used. These calculations are figured on each set or crew planting six acres per nine hour day, or a total of thirty acres per day.

In this schedule all of the workers would be paid the extra payment according to the number of acres each particular set planted above its requirements.

Our experience so far has shown that under the incentive or piece rate system our workers can and have earned anywhere from 25% to 75% more than they would otherwise normally receive for a regular nine hour day's planting work. Likewise our workers also found that during our harvesting operations under the piece work or incentive system they could earn more than by the previous day method and we, in turn, found that we could harvest our crop with little or no more labor than required during our regular cultivating season. This eliminated the need of hiring extra outside help, as we had been doing in the past, plus having to assume all the problems involving transportation, lodging and so forth that go with the employment of such workers.

Categories	Men Used	Example Rate	Total Cost	% Share Each Operation	Cost p/sq. Acre	Piece Rate per man
Two tractors opening land	2	$5.04	$ 10.08	4.29	$ .336	$.16
Ten tractors hauling seed cane	10	5.04	50.40	21.44	1.68	.16
Two tractors covering and packing	2	5.04	10.08	4.29	.336	.16
One Harvester (2 men harvester)	2	5.75	11.50	4.89	.383	.19
One Loader (1 man loader)	1	5.75	5.75	2.44	.192	.19
Loader scrappers	1	3.87	3.87	1.65	.129	.12
Two drain plows	2	3.97	7.94	3.38	.265	.13
Fixing and covering row ends	5	3.87	19.35	8.23	.645	.12
Planters (20 men on carts & 10 men in rows)	30	3.87	116.10	49.39	3.87	.12
TOTAL	55		$235.07	100.00	$7.84	

In instituting the piece rate system on a per acre basis for all workers in the cutting operation, we studied past performance records and used the average daily performance as the cutting requirement in establishing piece rates for this operation. These piece rates are:

Operation	Piece Rate Basis
Harvester Operator	$1.00 per sq. acre
Harvester Blademan	.75 per sq. acre
Salvaging)) after harvesters	3.00 per sq. acre
Crossing)	.20 per lineal acre
Cutting ends	.50 per lineal acre

On loading and hauling operations, we found that the crews covered an average of thirteen acres per nine hour day; so, extra bonus pay was paid to these workers after they had covered thirteen acres a day. This extra pay was:

Loader and derrick operators	$.06 per acre bonus
Tractor operators	.05 per acre bonus
All others involved	.04 per acre bonus

As in the case of planting operations, we also intend to continue the piece work system during this coming year's harvesting operations and to improve it, wherever possible.

I believe this about covers the subject, but if any of you gentlemen have any questions to ask, I will gladly attempt to answer them.

THE SUGARCANE BORER PROBLEM IN LOUISIANA TODAY

By A. L. Dugas, Entomologist--Louisiana Agricultural Experiment Station.

Because of the present interest in the sugarcane borer as a serious problem throughout the cane growing area of Louisiana, there appears to be need for a frank discussion of the practical aspects of the status of the insect and the available control measures. No attempt will be made to present the results of the many years of technical research by the Louisiana and Federal Stations except in the application of these findings to a better understanding of the problem from a more practical point of view.

Perhaps, one of the limiting factors in the failure of the cane industry to realize even more progress in borer control than has been made, is the lack of appreciation on the part of some of the growers and farm organizations of the importance of the problem and the complications that are involved. An attempt is made in this paper to discuss as briefly as possible some of the more pertinent phases which might lead to a better understanding of the general nature of the problem.

PRESENT AND PROSPECTIVE STATUS OF THE BORER PROBLEM

The relative importance of the insect and the corresponding amount of money that should be spent on its control depends upon the extent and level of infestation. This varies of course from year to year not only over the cane belt as a whole but on individual farms. The contribution of the experiment stations relative to the knowledge of losses, present status, and prospective outlook, is in the form of two surveys; one a fall survey of borer losses during harvesting; the other, an overwintering and mortality survey in early spring to determine winter carryover of borers.

Since it has been found that there is a close relationship between the borer population that successfully overwinters and the extent of losses at harvest-time, it is possible most years to predict with almost unbelievable accuracy what the borer infestation will be like the coming season. This information has been of immense value to the growers in making plans and preparations for their control program. All growers are urged to take advantage of this worthwhile data furnished by these surveys.

Now, what has the surveys indicated the last two years, and what is the prospects and status of the borer at the present time? The

harvesttime survey data showed that there were extensive losses in 1952 and '53, which followed carryovers of large populations of borers each year. Again this year, the overwintering survey revealed a heavy carryover and the first generation infestation at the present time is certainly indicative of this.

The general status of the sugarcane borer as a pest of cane and corn has changed considerably in the past two or three years. The insect occurred previously in localized areas in the cane growing area and for the most part on the more sandy front lands of the larger plantations. The prediction that the borer could very well become a more serious pest because of existing conditions has unfortunately been realized. The large acreage being planted to the very susceptible varieties, C.P. 44/101, C.P. 44/155 and C.P. 36/13 and the disappearance of C.P. 34/120, the extremely resistant variety, together with the occurrence of three consecutive mild winters favoring successful overwintering of the borer are the principal contributing factors to the present situation. Successful overwintering of large populations of borers is also attributed to the extensive amount of cane pieces and stalks that are left in the field during harvest under the present day speedy, mechanized system.

The borer is now a problem throughout the cane belt, on small farms as well as on large ones, on sandy soils and black soils alike, even in such areas as that of Bunkie-Cheneyville, Broussard-Youngsville, New Roads, St. James and parts of Bayou Lafourche, where the borer was unknown previously. An idea of the increase in scope of its seriousness is revealed by the fact that previously it was thought to be a serious problem on about 30,000 acres of cane, but with the increase and spread which has taken place the past three years and the extremely heavy first generation infestation in the fields at the present time, as much as 200,000 acres or more may be affected seriously this year.

Generally speaking for the cane belt as a whole, small farmers are now suffering heavier losses per acre than the large ones, since they no longer escape the problem and have failed to accept a control program.

DEVELOPMENT AND HABITS OF THE BORER

Some of you may wonder why ever so often you are exposed to some basic information regarding the life history and habits of the borer. The reason is simple, for the whole control program is based upon certain developments and habits of the insect. Such information as the different stages in the life of the insect, the habits of the larva and the adult moth, the number of generations each year, when and where it hibernates, and much more is essential for one to really understand and successfully control the pest.

There are four stages in the life cycle of the borer; namely, the egg, larva or borer, pupa or resting stage and the adult moth. In general,

this tells us what to look for in following the development of the borer through the season. The fact that the adult is a moth means that the infestation cannot be expected to stay put in a field. It also answers the question as to why fields with no dead-hearts may become heavily infested by the second generation. It is the influx of moths into more attractive cane.

In Louisiana, during late fall and winter, November to March, the borer is hibernating as a full grown larvae in cane pieces, stunted stalks, suckers and whole stalks left in the fields during harvest, in stubbles, in summer-planted cane, and in some years in shoots growing from early harvested cane. Small numbers sometime overwinter in Johnson grass or other large stem grasses. Under normal temperature conditions, overwintered borers begin to pupate in late February and March, and moths emerge in large numbers about the first week of April. This knowledge suggests the likehood of applying cultural practices to reduce the number of borers surviving the winter to the lowest possible level.

Starting about the first week of April, eggs are laid in masses of about twenty each on the small cane and sometimes on early planted corn to begin the first generation. The eggs hatch in four to eight days and the young borers work their way down into the bud or central whorl of the plant, where they feed from one to three weeks depending upon temperatures. This feeding in the bud causes leaf signs or leaf perforations, which are the first indications of borer infestation in the spring. The larvae then move down behind the leaf sheaths and there feed for a week or longer, the length of this period depending upon the favorableness of the weather. The time elapsing from hatching of the larva until it gains entrance into the plant is generally more than two weeks. This allows sufficient time for determining the fields that will need dusting and for making arrangements for applying the first application of poison for first generation control. First generation egg laying continues for about two or three weeks after general hatching occurs, consquently four weekly applications of poison are normally sufficient to cover the period.

In late May, deadhearts, the dying of the central whorl of the plants, resulting from feeding of the first generation, begin to appear. These borers reach maturity toward the end of May and the moths emerge and begin laying eggs for the second generation about the first week of June. Consequently, this is the time to release the egg parasites, Trichogramma. There is usually a period of about three weeks to a month between the appearance of the last eggs of the first generation and the first eggs of the second generation. Therefore, there is no need of insecticidal applications from about May 10 until June 15 to 20.

A general hatching of second generation larva occurs about the 15 to 20th of June. This is the clue for starting insecticidal applications for second generation control. By so doing, four weekly applications

of insecticides take care of the second generation in most fields. The newly hatched second-generation borers differ in habit from those of the first in that they very seldom do any feeding in the bud of the plant but move directly down the stalk to the inside of the leaf sheaths. Although there may be some leaf feeding, especially in heavily infested fields or in stunted cane, true leaf signs are generally not common enough to be used as a criterion for selecting fields for second generation dusting. In fields where there was little or no first generation infestation, therefore no deadhearts, the only available criterion is leaf sheath feeding. In fields that had medium to heavy first generation infestations the number of deadhearts per acre is a good measure.

It is usually about the first week of August when a general hatching of third generation eggs occurs. This generation is not so clearly defined as the first or second, but in most fields, there is a short period of time between the second and third during which little or no eggs are laid. There is of course more overlapping of the third, fourth and fifth generations of borers. The fact that third generation borers often concentrate in fields of stunted cane in which joints are just beginning to form and there do the same type of injury as the second generation does in normal growing cane, suggests the need of continuing the dusting to include third generation control in such fields.

This gives some indication of how control measures are tied in with the development, life cycle, and habits of the borer.

TYPE OF DAMAGE AND LOSSES CAUSED BY THE BORER

So many growers fail to realize the tremendous losses which are directly attributable to borer damage. The heaviest infestations follow the mild winters which are also conducive to good cane crops by accounting for superior stands, long growing periods, and better maturity. In such years, most growers make a better than average crop and consequently have a tendency to disregard the heavy losses from borers. With little or no borer damage in an excellent cane growing year like '53, the yields would have been beyond the imagination of most of us.

Feeding by the borer causes plant damage in many ways and losses are in relation to the level of infestation. Although some of the feeding signs do not produce losses, they are used as an index for measuring borer infestations.

1. Leaf feeding - The leaf signs or leaf perforations resulting from feeding of the young borer in the bud of the plant actually account for no harm, but are a means for determining the level of the first generation infestation at its beginning.

2. Deadhearts - The deadhearts caused by first generation borer attach are the first signs of plant injury, but these are not important losses, since there are no joints on the plants at that time, and suckers sprout out to replace the deadheart plants. The number of dead-

hearts is a means of measuring the first generation infestation near its completion, and an indication what to expect the second generation to be like.

3. Leaf sheath feeding - A typical discoloration of the leaf sheath is caused by feeding of the young borer larvae before they enter the plant. These signs are the only measure of second generation infestations in fields where no deadhearts occur.

4. Joint and stalk tunneling - Significant injury begins with the attach of second generation borers on the first 5 to 7 joints, and continues with later generations mostly on newly formed joints. This tunneling in the lower joints represents the most important damage. It stunts many plants which fail to produce millable stalks. This accounts for an uneven top line and makes the stand of cane appear much lighter. Eyes sprout out, with those below ground producing large green sprouts or suckers very low in sucrose. Tops die and fall over and in many cases the stalks break in two. Borer entrance holes and emergence holes are quite apparent upon stripping the leaves from the stalk. Splitting of the infested stalk reveals the borer tunnels and a high infection of red rot disease in susceptible varieties.

These stunted plants, broken tops and stalks, together with excessive eye sprouting make harvesting either by hand or machine very difficult and the stoppages and extra scrapping increase harvesting costs.

With an increase in borer injury there is a corresponding decrease in yield of cane and sugar, in sucrose and purity. Severe infestations may reduce cane yields in half and lower sucrose as much as 3 per cent.

Now, borer infestations are measured in terms of percentage of joint bored, but percentage of joints bored may or may not be a good measure of losses. In an extensive study of the effect of different levels of borer infestation upon various factors, we have found that with a natural or normal distribution of bored joints throughout the stalk that for each increase of one per cent in percentage of joints bored there is a corresponding decrease of .0984 joints per stalk; of .0457 feet in length of stalk; .0195 pounds in weight of stalk; .0566 per cent in sucrose content; .2058 tons in yield of cane; .8647 pounds of sugar per ton; and 43 pounds of sugar per acre. However, this same relationship of losses or damage to percentage of joints bored does not exist when cane is treated with insecticides, because the insecticides have sufficient effect upon reducing borer populations to change the normal distribution of bored joints, with the heaviest concentration resulting in the upper joints. This is a most important consideration in evaluating results from chemical control by dusting and will be mentioned later.

CONTROL

It appears that the only logical approach to the successful control of the borer is a broad, diversified control program embracing

cultural, biological and chemical control practices, to be later supported by varietal resistance, when and if resistant varieties are produced. With the more recent progress made through research by the Louisiana and Houma Stations this program nears reality. The author recommended such a program in 1943 in Louisiana Bulletin 363. This is certainly the most logical means of attacking the borer problem since it brings together the whole sugarcane area into a unified program and involves the use of all known control practices.

It should be made clear that it is unlikely that any one control measure will ever accomplish the degree of control desired, and it is not a matter of using one or the other but a combination of them to cope with the existing circumstances on any one place. The idea that parasites can be used instead of dusting should be discarded at once. We believe that the various cultural practices should be the basis of the control program, and should be adopted on all cane farms to hold the overall borer population to the lowest level, and then on places where the infestation justifies it chemical control should be resorted to. Biological control measures should be used to the best advantage to supplement the whole program.

Cultural control - With the advent of the cane top shredder and the accumulation of more definite information on destruction of overwintering borers in early spring, cultural control practices now available to the cane grower should become regular farm practices.

Although the shredding of cane tops is a new development, it has been talked about for a long time. In years of a light infestation, when the overwintering population of borers is mostly in the upper joints cut off with the tops, the shredding device will greatly reduce the carry-over of borers. In such years as 1953, when stunted stalks, suckers, broken tops and stalks constitute the bulk of the overwintering material, then the top shredder cannot possibly be as effective. However, shredding the tops will tend to increase borer mortalities resulting from wrapping of trash in the middles; make scrapping of fields much easier and more efficient; and conserve the organic matter furnished by the tops and trash.

By following the top shredding with proper use of chopping and wrapping to kill borers in the cane pieces and stalks which escape the shredder, much can be accomplished in effectively reducing the overwintering borer population.

All other cultural practices listed in the summary of control recommendations at the conclusion of this paper are of specific value in the overall control program.

Biological control - The use of parasites is a fascinating thing, and has proved a real asset to the borer control program in creating more widespread interest. It is doubtful that parasites alone will ever control the sugarcane borer in Louisiana. Nevertheless, there appears to be a place for both Trichogramma, the egg parasite, as well as larval parasites, such as the Cuban and Amazon Fly, for helping to suppress later generations following the dusting period.

If a field has a sufficiently heavy infestation to justify dusting, certainly Trichogramma will not control the borer in that field as wil dusting. The release of Trichogramma should be thought of as a sup-plement to the dusting program. However, it is only logical to assum that the use of biological and cultural control practices will result in ultimate decrease in the cane acreage which will need dusting.

Chemical Control - We think of chemical control, or dusting with ryania or cryolite in this case, as an immediate control for an infestation that is heavy enough to do damage in excess of the cost of the insecticidal application. It has no equal or alternate for the speci purpose for which it is designed.

Chemical control is recommended only where the proper check of fields reveals the borer infestation in a general area to be sufficien heavy to justify the expenditure. Furthermore, it should be done righ or not at all.

It is possible here to discuss only briefly some of the conflictin opinions regarding sugarcane dusting and the basis of the insecticidal borer control program.

A knowledge of the habits of the borer and the nature of cane growth revealed the apparent need of an early season poisoning progra because of the clearly defined nature of the first and the second genera-tion and the advantages in treating the small cane. There are usually no joints on the plant at the time of first generation attack so the pro-tection of the plant is of no particular value. First generation control is therefore a preventive type, however, its value lies in the fact that it reduces early infestations thereby decreasing succeeding generations which actually do the damage. Benefits at harvesttime depend upon a near complete destruction of the first generation over a sufficiently large area to prevent reinfestation by later generations. It is there-fore necessary that a large part of the infested area be treated so as to lessen the likelihood of an influx of moths from adjointing infested fields. For instance, small experimental plots in which a hundred per cent control of the first generation is obtained shows no benefits at harvesttime where surrounded by infested cane.

However, during the time of second generation attack five to seven joints are formed and its control gives actual protection to joints and benefits that are measurable at harvesttime. Although some bene-fits are lost by injury from reinfestation by later generations, the los-ses are not in proportion to the percentage of joints bored because the late injury is mostly in the upper joints where losses are less severe. Although outstanding harvesttime differences can be demonstrated in small plot second generation tests, more effective control in the end is dependent upon a sufficiently high kill of second generation borers and a minimum oı reinfestation.

The long period of time elapsing from the last application of dust until harvest therefore presents certain risks and necessitates near complete treatment of infested areas. The present trend of

thought is toward extending the control period nearer to harvest which is now a possibility since some of the newly introduced varieties of cane grow rather openly at the top allowing dusts to better penetrate in later stages of growth. Very definite benefits are obtained from controlling the third generation, especially in small plant cane where damage may sometimes be quite severe.

Among the more pertinent considerations in a chemical control program of the borer are the proper checking of fields to determine when and where to dust; proper timing of dust applications; the use of at least the recommended minimum dosage rates and number of applications; proper application of the insecticide; treatment of general areas and not scattered fields; and wise interpretation of results, which merits further explanation.

Interpretation of Results from Chemical Control of the Borer - It seems important that the growers should better understand the effects of chemical control on borer infestations in order to be in a position to analyze results more accurately. The following considerations must be kept in mind in passing judgement on the efficacy of dusting cane for borer control:

1. Chemical control cannot be expected to eliminate all bored joints. Protection of lower joints will allow as much as 35 per cent infestation of upper joints in cane showing a 6 ton increase from dusting.

2. If recommendations are followed, the fields selected for dusting should meet the minimum borer infestation requirements which should produce destructive infestations by harvesttime. Therefore the dusted areas are the ones in which you would anticipate the worst injury so there is no reason to expect to find less borers in these than in most of the undusted fields, which may have started out with little or no borers.

3. Comparisons of dusted and undusted cane should be made in cane of the same variety, same age, similar growth, having approximately the same infestation to begin with, and within close proximity so as to be subjected to the same conditions.

4. The undusted fields would certainly be subject to much higher infestations if nothing has been done in the areas showing early infestations sufficiently heavy to justify dusting.

5. Chemical borer control is more effective some years than others as is weed control, fertilization and other practices.

6. Gains from dusting are proportional to level of borer infestation. The greatest gains or returns from the expenditure are obtained from the highest infestations, although there may be more evidence of borers at harvesttime in such treated fields that in fields treated for a light infestation.

7. Percentage of joints bored at harvesttime in a dusted field is not a true measure of losses, since the dusting causes a change in the location of the bored joints, moving the infestation to the upper joints which results in less injury. The percentage of joints bored shortly after the dusting is terminated is actually a more accurate

measure of injury than the harvesttime figure.

8. The protection of the plant from borer injury to the lower joints at the most critical time, in June and July, allows the plant to grow to be a millable stalk regardless of the later reinfestation in the top joints.

9. Treated fields, especially for first generation control, may become thoroughly reinfested and erase all benefits of the dusting.

10. Finally, the aim of a dusting program is to reduce the borer infestation over a whole farm or community, so it is unfair to judge results by what occurs in small localized areas.

A SUMMARY OF RECOMMENDATIONS FOR CONTROL OF THE SUGARCANE BORER

The following is a brief outline of the more significant recommendations.

1. Shredding of cane tops - Shredding of the tops to reduce the number of borers entering hibernation in joints left on cane tops and to add humus to the soil.

2. Make thorough clean-up during harvest - The main source of borer infestation in the spring is from cane material left during harvest. A special scrapping will often yield enough cane to pay for the operation besides reducing carryover of borers. It is also helpful to remove all stalks and pieces of cane from roads, railroads, and about the factory and derricks.

3. Burn trash cane pieces, tops, etc. thoroughly - Thorough burning reduces overwintering borers by 60 to 70 per cent. Shredding of tops would eliminate necessity of burning.

4. Chopping, wrapping of middle, and shaving and wrapping - has been found to reduce overwintering population by 76, 88 and 92 per cent, respectively, as compared to 20 per cent where nothing was done. Thorough burning or shredding is necessary to eliminate bulky tops, which wrapped with the pieces lowers mortalities of the borers.

5. Shave summer planted cane and destroy plants - A heavy borer population may be found overwintering in shoots of summer planted cane.

6. Start spring cultivation in fields heavily infested the previous year - Early cultivation will destroy many stages before the moths emerge.

7. Concentrate corn plantings and isolate the plantings if possible - Corn can be a source of heavy reinfestation for treated cane. Concentrated plantings facilitate dusting when needed and prevent spread of borers.

8. Cut out and destroy heavily infested corn - Quite frequently heavy first generation infestations are concentrated in rather small areas of early developing corn, which may produce as many as a hundred thousand borers per acre.

9. Control the first, second or third generations by dusting with ryania or cryolite.

10. Release Trichogramma egg parasites to maintain parasite population at highest possible level.

11. Release of the larval parasites (Cuban and Amazon flies) - Extensive experimental releases are being made by both stations this year to determine the good that may be derived from them. They are not recommended at the present time.

12. Plant borer-free cane - This insures good stands and healthy plant cane. Germination and vitality of plants may be lowered considerably by use of heavily bored seed cane.

13. Harvest heavily infested cane as soon as possible - This prevents additional losses; allows more time for breaking stubbles; and increases overwintering mortalities through early harvesting.

14. Cut cane at ground level - Cane should be cut at ground level to reduce number of borers overwintering in cane stubbles. Cutting of cane lower to include the first joints also increases sugar production.

15. Fall-break stubble fields - Thorough breaking destroys all overwintering material.

THE IRRIGATION OF SUGAR CANE

By R. J. LeBlanc -- Godchaux Sugars, Inc.

The purpose of this experiment is to determine if there is some way which is profitable, in the time of drought to be able to give the sugar cane its required amount of moisture.

In 1952 a Webster Portable irrigation system with a Hale pump and 8 cylinder Chrysler engine for the purpose of conducting experimental work in the irrigation of sugar cane was purchased.

The system cost approximately $8,000. It has 800 ft. of 8" aluminum pipe consisting of 40 length 20' long and 1320 ft. of 6" pipe consisting of 66 length 20' long and 8 sprinkler heads. The 8" pipes are used for the cross line and the 6" pipes for the lateral lines. There are enough lateral pipes (6") to set up two lateral lines, so that while one line is irrigating the other one is being set up so that when the first line is finished all that is done is close one valve on the directional valve and open the other. This can be done without stopping the pump.

This machine can irrigate an area of approximately 3 sq. acres with a setting at the rate of 1 inch per hour and the machine set at 2200 RPM and can cover an area of 27 sq. acres before moving the pump.

To operate the system it takes one man to operate the pump and four men to pick up and set up the line. To lay the line down the men carry the pipes down the row and couple them as they go. The pipes are connected together by a Triggerlock. To lock, insert one pipe into another allowing trigger to drop in slot. To unlock, push pipe together, twist slightly and withdraw. After the irrigation is completed on that line the men go down the cut, uncouple the pipes and carry them 200 ft. across the cut to where the next setting will be made.

Should it be necessary to extend the 6" line more than 680' the line can be extended up to 980' without the friction loss exceeding the pump design head, the only time loss would be the time lost to set up each setting.

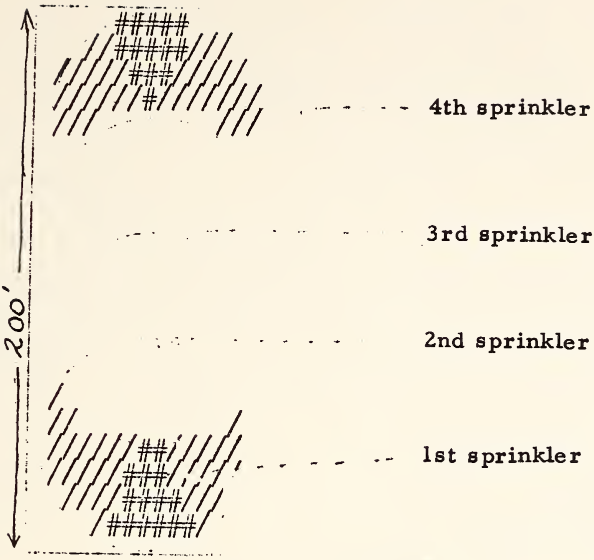
The weight of the pipes are: the 6" pipe for the lateral line is 1.365 pound per foot and the 8" pipe weighs 2.802 pound per foot.

The pump is a Hale single stage centrifugal pump directly connected to the bell housing of the Chrysler Industrial 8 cylinder engine. The whole assembly is neatly and ruggedly mounted on a structural iron frame. The drive to the pump is through flexible rubber cushions.

At the present time it is too early to say what good can be derived from the irrigation of cane as there has not been enough work done on this to determine whether it would be profitable or not.

Work was started on July 15, 1952, this was following a three

Pattern of Coverage



Precipitation

160' x 160' Spacing with an 8 MPH wind

Clear areas	1.0" per hour
//// areas	.6" per hour
#### areas	.3" per hour

160' x 200' Spacing with an 4 MPH wind

Clear areas	.72" per hour
//// areas	.48" per hour
#### areas	.24" per hour

month drought. The cane received an application of 3 inches of rain at the rate of 1" per hour covering an area of 160' wide and 680' long. Thr days after this cane was irrigated we had 1.8" of rain and from then th rain continued periodically until September. Had it been possible to st this work at the beginning of May before the cane had suffered from the drought, results may have been obtained then.

During September through the middle of November there was another drought and the plant cane began to suffer from the lack of moisture. Then 110.0 acres of plant cane in heavy soil were irrigated. In three areas there was a small number of acres where enough water was not available to complete the section and these were used as check plots The cane that was irrigated received water at the rate of 3". In the spr there was considerable difference in the cane that was irrigated and the one which was not. In some sections that were not irrigated the cane di not come up and where it did come up there was a very poor stand.

In 1953 we followed up the work which we had started in the fall, 122.0 acres were irrigated from May 28th through July. After July 1st there was enough rain to discontinue the use of the irrigation system. However in September the plant cane began to suffer from lack of water, but due to a shortage of labor we were unable to do any irrigation at the time. Quite a number of acres had to be replanted and more will have tc be destroyed this spring.

In the areas that were irrigated some received 1 application of 3' of rain and some received 2 applications two weeks apart.

The cost of irrigation, taking in gas, oil and labor was $7.43/acre/application of 3" of water. However, this cost does not take in any depreciation on the unit.

Results:

Utopia Plantation: Heavy soil CP36-105 plant cane. Planted Sept. 23, 1952, irrigated Oct. 14, 1952 with 3" water. This was the only irrigation it received.

Yield	Irrigated	16.0T/A
	Check	13.5T/A

Utopia Plantation: Heavy soil CP36-105 plant cane. Planted Aug. 12, 1952, irrigated Aug. 21 with 3" water; October 20, 3" water; June 1, 3"; June 19, 3".

Yield	Irrigated	18.6T/A
	No Check	

Raceland-Mary Plantation: Heavy Soil CP44-101 plant cane. Planted Sept. 11, 1952. Irrigated June 10-15 with 3" water. Only application it received.

Yield	Irrigated	26.0T/A
	Check	20.1T/A

Both plots were planted the same day in the same type soil.

A special experiment on Co290, CP34-120 and CP29/320 was made to determine if additional moisture were given, whether these varieties would show an increase in yield, or if they had just played out. Results:

Co290	15.50 T/A	CP29-320	13.72 T/A
CP34-120	11.87 T/A		

On September 10, 1952 immediately after planting all three varieties received 3" of water. On Oct. 9, 1952 another 3" of water was applied. On May 28 and June 17 another 3" on each of those dates was put on.

Difficulties experienced with the Irrigation System:

You must have a good supply of water available near each section you will irrigate. With one system it is difficult to cover many acres.

At the time of irrigation it is very difficult to keep the same men on this work, because of the heat in summer, and many times you have to start training a new crew.

Under the present conditions it is difficult to say how much more work we will be able to do in the future, but if possible more work will be done to see if this work would be profitable and economical to the Sugar Industry.

A REPORT ON THE PROGRESS OF THE CONTROL OF STUNTING DISEASE

By Lloyd L. Lauden, Agronomist--American Sugar Cane League

Very soon after Dr. E. V. Abbott, Superintendent of the U.S. D.A. Houma Sugar Station, recognized the presence of Stunting Disease in Louisiana a subcommittee was appointed by Stephen C. Munson, Chairman of the Contact Committee of the American Sugar Cane League, to advise the industry on a control program for the disease. Those named to the Committee were A.H. Feske, Jr., Chairman, E. V. Abbott, Louis Arceneaux, S.J.P. Chilton, J. Norman Efferson, Elliott Jones, W.G. Taggart, and the writer.

At the Committee's first meeting, July 8, 1953, a recommendation that growers practice seed selection was made. Growers were told that seed taken from stubble plots showing vigorous growth and uniform height would not result in complete control, but this practice would reduce the amount of the disease as compared with plantings from plots not selected.

Later in the summer of 1953 the committee recommended that the American Sugar Cane League construct a heating chamber to treat cane on a large experimental scale with hot air. The Executive Committee of the American Sugar Cane League appropriated funds for the construction of this unit. This heating unit was designed by Mr. Harold Barr, Head of the Department of Agricultural Engineering, and Mr. Wiley Poole, Agricultural Engineer, of Louisiana State University, and was constructed on a trailer truck owned by the Department of Agricultural Engineering. This unit treated 5 tons of cane in an eight hour period.

Since this was the pioneering stage of treating cane on a large scale with warmed air, much difficulty was encountered in maintaining an even distribution of heat. In spite of the many difficulties experienced, 130 tons of seed were treated at 9 locations by Mr. Leon Nugent, who operated this unit for the League.

In 1954 the committee recommended that the League rebuild the 1953 unit. An additional appropriation was made by the League for this purpose. The contract for designing the 1954 Heating Unit was awarded the Heating and Refrigerant Consulting Engineering firm of Ogden and Woodruff of Baton Rouge. Mr. Lewis Doherty of Baton Rouge was awarded the contract to construct the unit. After the construction of the unit was completed, it became apparent to the committee

that this unit also offered many problems in controlling the distribution of the warmed air. Fully three weeks was spent by Mr. Luther Farrar, Pathologist employed by the League to operate the unit, and the engineers of the firm of Ogden and Woodruff in attempting to balance the distribution of air.

After much time and expense, the unit was finally operated at a higher than preferred intake air temperature in order that cold spots in the chamber might be raised. Unfortunately, germination was reduced because of the use of high temperatures. Though many breakdowns and difficulties were experienced, Mr. Luther Farrar of L.S. U. and Mr. R.L. Tippett of the U.S.D.A. managed to treat approximately 200 tons of seed in 1954. In both the 1953 and 1954 treatments, germination appeared better from seed treated before October.

Heat-treated cane covered lightly or shaved early also appeared to have better stands the following spring than those covered deeply and not shaved.

From the two years of operation, the three agencies have approximately 135 acres of seed available for commercial distribution this year. This will be distributed in the same manner new varieties are handled and in accordance with the agreement of the three cooperating agencies, the U.S.D.A., L.S.U., and the A.S.C.L.

While the large scale experimental work was being conducted, Dr. Charles Schexnayder, Pathologist, U.S.D.A., Houma Station, and Dr. Rene J. Steib of L.S.U., constructed two small 4 x 4 x 8 electrically heated units.

The ease at which the distribution of heat was controlled in the two small units constructed at the two stations, as compared with the difficulty of maintaining even distribution of heat in the large mobile unit, made it obvious that better control could be maintained with smaller units.

Many in the industry requested that the committee make plans available of plantation scale units. Early in 1955 considerable time was taken to study the design and operation of heating units that had been constructed on several plantations. Much time and effort was also spent in designing and operating smaller units.

Operational temperature checks were made on three gas heated units on three plantations. The committee has made available to the industry plans of one of these units. This unit has been designated as Unit III. An operational temperature check sheet is attached to the small copy of the drawing of Unit III in this paper. This unit has a 2400 pound capacity and can be seen at the Greenwood Plantation near Thibodaux, La.

Two other units, smaller in size, were designed for the industry's use and designated as Unit I and II; both units are electrically heated, having a capacity of 800 and 2400 pounds of cane, respectively. These two units are basically alike in design to the two units that have been in successful operation at the U.S.D.A. and L.S.U.Stations

for the past two years. A heating unit similar in size to Unit I can be seen at either the L.S.U. Station or the U.S.D.A. Station. Attached to this report is a small copy of a drawing of Unit I. Operational temperature checks made on the small units in operation at the two station indicate very even distribution of warm air, having a plus or minus 2 degree Fahrenheit variation.

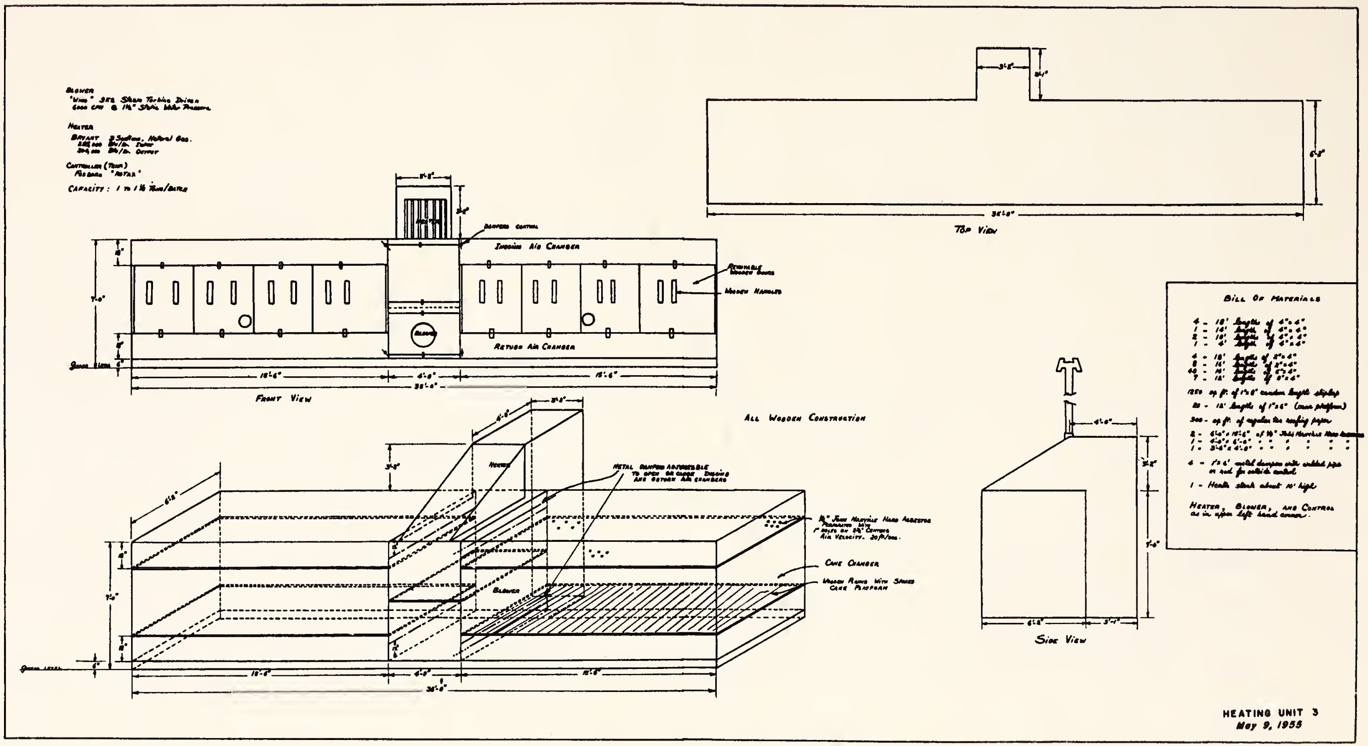
Unit II can be seen at the Smithfield Plantation at Chamberlin, Louisiana. An operational temperature check sheet is attached to the small copy of a drawing of one part of Unit II in this report. Plans for Units I and II have also been made available to the industry by the committee.

Answers received from an inquiry sent out indicates at least 30 units will be constructed this year. Since the plans were made availab to the industry, Dr. R. J. Steib has interested Mr. Lewis Doherty, a contractor of Baton Rouge, Louisiana, in offering to construct and sell Unit II complete. Mr. Doherty will also make up for sale an electrical kit for heating Unit II for use by those who wish to construct their own unit.

During the two years work with this disease the committee received technical advice and many services from Professor Harold Barr Department of Agricultural Engineering, L.S.U.

Dr. Rene J. Steib of L. S. U. and Dr. Charles Schexnayder of the Houma Station have been commended by the committee for their untiring efforts in their work with the committee.

The committee is also indebted to the Increase Station operators for the time and money spent in taking part in the cane treating progran

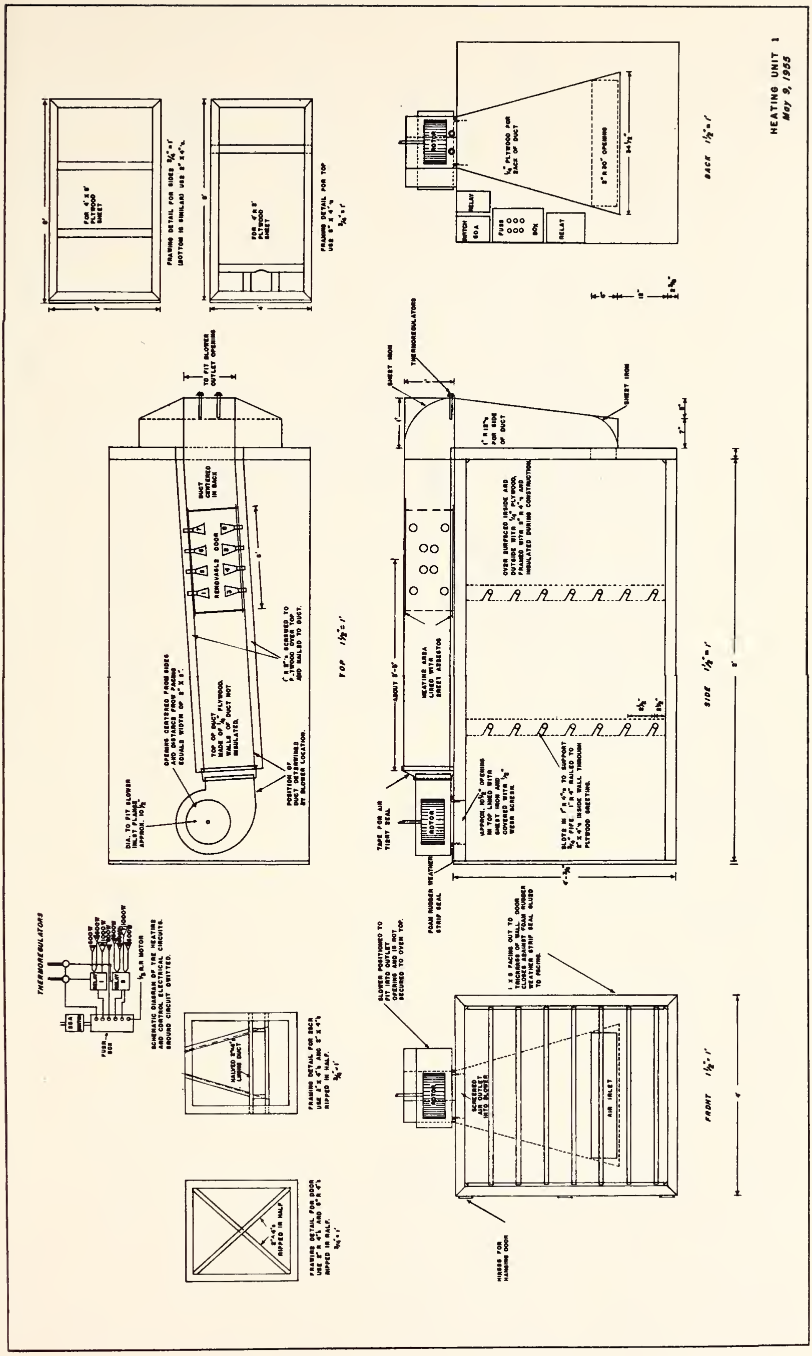

Front View
Top View
Side View
Incoming Air Chamber
Return Air Chamber
Cane Chamber
Heater
Blower
All Wooden Construction
Bill Of Materials
Heater, Blower, and Control as in upper left hand corner.
Capacity
HEATING UNIT 3
May 9, 1955

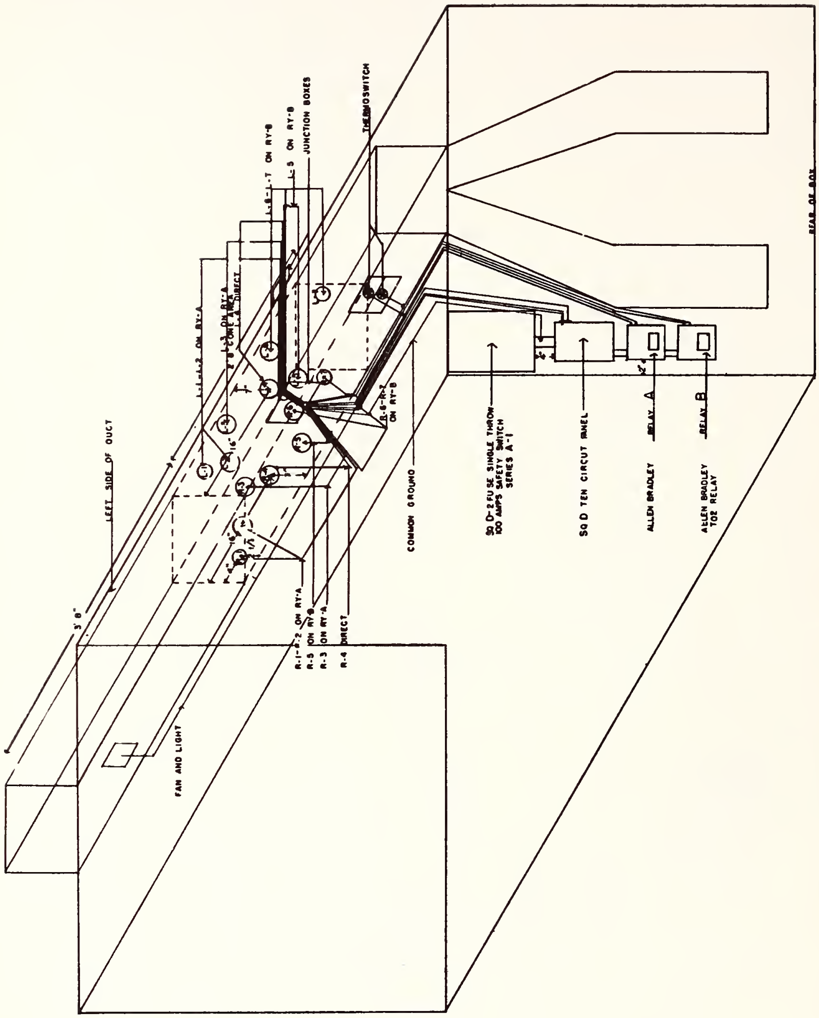
ONE OPERATIONAL CHECK ON UNIT III

	Thermocouples inside stalks of cane									Fahrenheit								Thermocouples in Air							
	1	2	3	4	5	A	B	C	D	1A	2A	3A	4A	5A	6A	7A	8A	Nickel A	Nickel B	Nickel C	Duct Front Top	Duct End Top	Duct End Bottom	Inlet	Outlet
																		Centigrade			Fahrenheit				
10:45-11	68	72	69	72	66	79	79	70	75	82	75	79	84	94	86	101	82	20	23	37	110	110	76	122	100
11:15-11:30	88	96	92	91	85	114	108	93	105	107	101	105	110	110	99	115	101	35	41	50	130	129	112	132	99
11:45-12:00	113	113	115	114	99	125	123	110	119	118	112	115	115	123	114	127	116	43	49	55	132	132	112	136	115
12:15-12:30	115	122	117	115	114	127	127	120	123	124	121	122	124	126	120	129	122	50	53	55	138	134	120	134	120
1:00-1:15	123	126	123	120	120	128	127	125	124	126	124	126	126	129	125	130	126	52	54	56	138	135	122	135	122
1:45-2:00	126	128	127	122	126	128	128	126	124	127	126	127	128	131	126	132	127	53	55	56	138	132	121	135	124
*2:45-3:00	138	128	130	128	126	133	131	131	129	128	126	127	127	128	127	127	126	53-1/2	55	55	132	132	124	132	124
3:15-3:30	125	125	126	126	125	127	127	127	124	126	125	126	126	126	125	127	126	52	53	55	136	134	122	136	124
3:45-4:00	123	125	122	123	121	127	126	124	124	125	127	125	127	128	125	130	126	53	54	56	138	132	122	138	124
4:15-4:30	125	126	124	124	124	127	128	126	124	126	126	126	127	127	126	129	126	53	54	56	135	133	121	134	124
5:15-5:30	128	128	125	125	125	128	128	127	125	127	125	126	126	128	126	129	126	53	54	56	134	130	120	134	124
6:15-6:30	127	128	126	127	125	130	129	128	126	126	126	126	127	128	126	129	126	53	54	56	133	130	118	134	122
6:45 out																									

Date Feb. 15, 1955 Variety 44-101 Pounds 2020

Start 10:45 A. M. *Current failed--Unit went off until 3:15 Location Greenwood


HEATING UNIT 1
May 9, 1955
BACK
SIDE
TOP
FRONT
THERMOREGULATORS
AIR INLET
REMOVABLE DOOR


LEFT SIDE OF DUCT
FAN AND LIGHT
JUNCTION BOXES
THERMOSWITCH
COMMON GROUND
SQ D-2 FUSE SINGLE THROW 100 AMPS SAFETY SWITCH SERIES A-1
SQ D TEN CIRCUT PANEL
ALLEN BRADLEY
RELAY A
ALLEN BRADLEY 702 RELAY
RELAY B
REAR OF BOX

ONE OPERATIONAL TEMPERATURE CHECK
ON UNIT II

	Thermocouples inside stalks of cane														Fahrenheit											In Air Centigrade			
	1	2	3	4	5	A	B	C	D	E	6	7	8	9	10	11	12	1A	2A	3A	4A	5A	6A	7A	8A	A	B	C	
7:30-8:00	79	74	73	74	75	76	78	79	78	79	77	77	79	80	100	79	85	87	85	78	81	88	89	97	94	38	43	44	
8:30-9:00	108	101	96	98	98	104	98	113	101	106	94	90	104	94	129	118	118	117	115	107	111	114	117	120	121	49	53	55	1 hr.
9:30-10:00	121	117	112	112	115	126	113	124	117	121	112	106	119	107	130	127	125	124	122	119	120	124	125	125	127	51	55	55	2 hrs.
10:30-11:05	127	123	122	121	125	128	123	127	123	124	121	116	125	117	131	129	129	126	124	124	122	128	127	126	127	53	55	55	3 hrs.
11:30-11:55	125	124	126	124	127	130	123	129	124	125	123	120	127	120	130	132	129	126	125	125	124	128	128	127	128	53	56	56	4 hrs.
12:30-1:00	126	126	124	125	127	130	126	127	125	126	123	123	127	125	131	130	128	127	125	126	124	128	126	127	128	54	56	56	5 hrs.
1:30-2:00	125	125	125	125	127	129	126	128	124	126	125	123	127	125	131	129	129	127	125	126	125	127	128	127	129	54	56	56	6 hrs.
2:30-3:00	125	125	125	125	125	128	127	127	125	127	126	124	127	123	131	129	130	128	126	126	125	128	128	127	129	54	56	56	7 hrs.
3:30-4:00	126	125	125	125	126	128	126	128	125	127	124	124	126	123	131	129	129	128	126	127	126	128	128	128	129	54	56	56	8 hrs.

By R. J. Steib, Charles Schexnayder, and Lloyd L. Lauden
April 21, 1955

Location - Smithfield
2400 pounds

FIELD-MADE SOIL CONDITIONERS - HUMUS

By F. Evans Farwell

In our never ending search for cheaper ways to produce more sugarcane per acre and more sugar per ton, we must constantly re-examine cultural methods and procedures to be sure that they are actually paying their way and not just being continued from custom.

With better varieties, more and better fertilizers, disease controls-including control of stunting disease, we should expect in the future to be able to remove each year greater and greater quantities of sugarcane from our lands. Will our lands sustain such heavier yields under present procedures?

Certainly, we shall need a deeper root bed and one that is in the best possible physical condition.

Dr. Alderfer of Rutgers University made a most interesting statement in this connection when he said: "Plants cannot make the most efficient use of fertilizer in soils whose plumbing, heating and ventilation systems are out of order." He is certainly right in pointing out that in order to provide "proper living quarters" for plant roots having easy access to a plentiful supply of moisture and nutrients.

Dr. Arthur M. Smith of Mathieson last year made two observations along these lines that are well worth repeating here:

1. The New Jersey Agricultural Experiment Station reported that Anhydrous Ammonia, used in soils containing an appreciable amount of organic matter, is an excellent soil conditioner. The ammonia dissolves the humus in the soil, and completely combines with the clay particles. The humus is thusly deposited on the mineral soil particles, binding them together in water-stable aggregates-as good as those formed by commercial soil conditioners.

2. But in heavy soils, such as silt loams and clay loams, which are deficient in organic matter, the ammonia tends to puddle the soil. The absence of sufficient organic matter to be dissolved and act as a conditioner, results in the soil becoming stiffer and more difficult to plow.

Let us review a bit the organic matter-humus set up. Humus is decomposed organic matter, decomposed in the soil by bacterial action. Humus is a dark-colored, jelly-like substance composed of many complex organic compounds. It is not a permanent thing; instead it is continuously being formed from added plant materials and continuously being "burned out" by cropping, plowing, etc. To form the humus, bacterial action is necessary.

The bacteria or micro-organisms must be properly fed while

they are converting organic matter to humus:

1. Because bacteria are more efficient than plant roots in picking-up soil nitrogen, there is danger of the growing crop being starved of nitrogen.

2. If the supply of nitrogen is insufficient to support the large bacterial population, the breaking down process will be so slowed that oxidation will dominate. Oxygen will combine with the organic matter and form carbon-dioxide gas which readily escapes from the soil. This occurs when the nitrogen-carbon ratio of 1 nitrogen to 12 carbon gets too far out of balance, say, 1 nitrogen to 50 carbon. Nature adjusting the ratio causes the loss of valuable carbon.

The nitrogen utilized by the bacteria in the manufacture of humus is temporarily "tied up" in their bodies but is returned to the soil in a leach-resistant form after the manufacture of humus is completed and as the bacteria die.

It is interesting to note that by using tracer techniques, soil scientists at Iowa State College found that soil microorganisms will selectively absorb ammonium nitrogen and will reject nitrate nitrogen when both forms are present for their use.

The healthy and lively micro-flora found in soils well supplied with humus no doubt tend to restrain root rotting organisms. Dr. Wm. A. Albrecht even suggests the possibility plants may need organic as well as inorganic compounds for their proper nutrition. He reminds us that soil organic matter serves to grow antibiotics; that hogs fed sod or its equivalent in antibiotics make healthier growth than those held to dry lot feeding only.

To help control Johnson grass, we have fallow plowed intensively and this mainly during the hot summer months. As a result, we have destroyed a large part of our soils' humus supply. To economically harvest cane, we have burned the leaves and some of the tops. For borer control, we have gone back and reburned as many of the tops as possible, further depleting our supply of humus. It is hoped that in the near future most of our cane can be harvested in such a way that all of the cane except the millable stalk will remain in the fields. Then the leaves and shredded tops (this giving great aid to borer control) would act as a mulch to protect against soil erosion during the winter rains, and later they would be plowed into the soil to increase its organic content and humus.

Generally speaking, where possible, it would be well to keep our lands covered with a growing crop or a mulch throughout as much of the year as possible.

Let's examine some of the benefits that we may expect from a greater humus content in our soils:

1. Very sandy soils tend to have poorer yields mainly because they are not able to retain the chemicals used by the plants for growth, just as such soils are unable to properly retain moisture. When humus is added to these soils, their body is so improved that increased yields

can be expected. When humus is added to very stiff heavy soils-black jack-the soil's water-holding capacity is increased, it is better aerated and becomes easier to work.

2. Because of the ability of soil with a high humus content to absorb and hold the minerals of the soil, the loss of minerals from erosion is greatly reduced.

3. Humus will help make available vital minerals that may not otherwise be available to the plant and of course increases the water-holding capacity of the soil. A plant's supply of nitrogen (N), phosphoric acid (P_2O_5), and potash (K_2O) is available to the roots in the soil solution. If the soil is "rich", the required nutriment is contained in a relatively small volume of soil solution-water. Where the soil is "poor" naturally a greater volume of water must be taken in by the roots for the required nutriment; which, of course, causes the plant to take up and transpire a relatively larger quantity of water to satisfy its nutriment requirement. So, in a dry period, the poorer soil has a greater water requirement than a richer soil; to say it another way, well fertilized soil requires less water to produce the same yield than is the case with soil having a smaller plant nutriment content.

Let us note the water requirements per bushel of corn with adequate fertility:

Adequate fertilizer applied		No fertilizer applied
79	Bu. produced/acre	18
16	Inches soil water used	14
5,600	Gals. of water/bu. of grain produced	21,000
Corn on soil with adequate fertilizer had roots to a depth of 4 feet		Corn on soil with inadequate fertilizer had roots to a depth of less than 2'

Without adequate nutrients, it could not develop a sufficient root system to utilize moisture in the subsoil.

Let us consider the interrelation of minerals and the importance of balanced nutrition.

Using the "soil rumen" idea like the animal rumen idea, we find that soil bacteria fed a <u>heavy</u> <u>balanced</u> diet of nitrogen, phosphorus, and potash will respond quickly by breaking down organic matter into humus, which in turn helps store these materials for future use.

M. J. Plice of the Oklahoma Experiment Station set out to find out why it was that cattle avoid the lush green tufts of grass in pastures. Certainly, the grass which had received a large supply of nitrogen from previous droppings had a beautiful color, it was tall, and had a thick

growth. To the human eye it was ideal, yet cattle preferred the smaller but normal grass plants. Chemical analyses of both kinds of grass plants showed the lush manure-affected ones were lower in phosphorous and sugar. When they were sprayed with molasses or sugar water, they were readily and completely devoured. Manure being high in available nitrogen causes a luxuriant growth of plant substance at the price of low phosphorous intake. In plant physiology, sufficient available phosphorous is necessary for proper sugar metabolism.

Dr. William A. Albrecht says that "too much is too much" only in relation to something else. "If too much nitrogen is used in relation to the supply of phosphate, potash, calcium, or other growth factors, the unbalanced situation causes trouble." Animals instinctively select food which provides a balanced ration. Rabbits in tests preferred grass grown with complete or no soil treatment to grass where nitrogen alone was used. Dr. Albrecht says plants, unlike the cow, cannot easily pass up the place where there is too much nitrogen or, rather in the converse, where there is an unbalance of nutrient elements. Root growth does suggest that plants do try to make selective searches through the soil, but where there is an unbalanced condition such as too much nitrogen in relation to the other elements, lodging and excess bulk tend to result. Plants and animals both require a balanced ration.

In our cane culture, we must never forget that a 20 ton crop of cane removes 37.6# of nitrogen, 12.6# of phosphorous, and 97.3# of potash from the soil. If we seek greater yields, we must be sure that the soil ration is adequately balanced and in a form to be properly fed to the growing plants.

It is the nature of plants to require the presence of much larger amounts of nutrients in the soil solution than they can, under normal conditions, absorb. In other words, for maximum yields, a plant might require the presence of 2200# of nitrogen per acre in spite of the fact that the plant can only usefully metabolize some 300# of this nitrogen. Soluble nitrogen in the soil water is subject to having its nitrogen ions absorbed by the cells of the roots of the plant which constitutes the base of the plant's proteinous substance; but it also exerts osmotic pressure when the soil solution becomes concentrated by evaporation. So, we have a danger when the properly fertilized soils receive insufficient moisture because evaporation in raising the concentration of the nitrogen in the soil water increases the osmotic pressure, which in turn forces too great an amount of nitrogen through the membranes of the root cells. Because of the inverse yield-nitrogen law, the sugar cane plants can only usefully and normally utilize a certain or limited amount of nitrogen. If more is forced into them, difficulties develop. Lack of rainfall or soil moisture in such a case will give trouble-plasmolysis-shrivelled, inefficient leaves unable to do their proper work. The same is true where there is an excess of phosphate and/or potash, though not to the extent as in the case of nitrogen. We have witnessed some such cases of poor yields in recent years,

and the basic answer appears to be irrigation, but there are many who hesitate to make the required investment.

Until cheaper methods of irrigation have been developed, we might do well in attempting to work out a temporary solution, by increasing the plow depth, rupturing the hard pan, and increasing the humus content, which in turn will enable the soil to retain more moisture in drought periods.

When the plant food supply is in the form of rotted organic matter the chemical fertility of the soil is at its best stage. Hot weather crops like sugarcane are fed nitrogen and other minerals as these are needed by the growing crop. The release of the humus nitrogen increases with the temperature and the availability of moisture. The plant food is in a non-leaching form, so that when there are periods of excessive rain, the leaching loss is minimized, but the plant foods are released to the growing crop as they are required.

The placement of the nutrients in the root zone leaves them in an ideal position to properly feed the plant. The improvement of the physical condition of the soil by humus is possibly one of its most attractive characteristics. The tilth of heavy soils is greatly improved where the humus cements fine soil particles into aggregates. In very poorly drained soils that are not in good physical condition, nitrogen is lost into the air during very wet weather. When these heavy soils are so saturated with water, air and oxygen are almost completely missing. Under this condition, soil microorganisms take oxygen away from nitrate nitrogen, releasing gaseous nitrogen, causing puddling. Such puddled conditions are often observed as being areas of actual nitrogen deficiency. Organic matter would help. It must never be forgotten that root hairs through which plants feed must have oxygen from the air in contact with them, or they cannot feed effectively on the plant foods around them.

It should be stated here that there is no intention to advocate discontinuing the planting of soy beans and such legumes in the spring, but if it is agreed that our intention is to try to increase the organic matter-humus-of our soils, we should consider various experiments that may lead us to the desired end faster than under procedures we are now following. About three-quarters of the organic matter in a young green manure crop is digestible by a cow, which certainly indicates that it is quickly and almost completely decomposed after being turned under in the soil. Legumes certainly improve the physical condition of the soil during the few days when they are decomposing rapidly, but their ability to increase the organic matter, water-holding capacity, etc., is smaller than most realize.

Possibly we should buy our nitrogen and grow our organic matter.

It is hoped that greater interest in these matters may result in a series of experiments that could prove beneficial to our efforts to increase the number of pounds of sugar that we can harvest each year from an acre of ground. One large difficulty in such experiments so far is to find a

crop that will mature sufficiently within the time available so that a large volume of organic matter can be plowed down and rotted sufficiently in advance of the usual cane planting time.

Some experiments being conducted with the purpose of increasing humus content:

1. Rye grass was planted on land where the stubble was plowed out in the fall. The roots intruded thoroughly everywhere in the cultivated layer of the soil and they also left behind humus, which tended to maintain channels created in the soil by the growing roots. The physical condition of the soil appeared to be improved even though the land was fallow plowed from the time the rye grass was plowed-under until cane planting time. The difficulty in handling such rye grass occurred one year when incessant rains prevented the plowing-down of the rye grass cover crop at the proper time, before it could make seed. Such danger would limit the acreage that could safely be planted to rye.

2. Soy beans were plowed under during the first two weeks in June. After harrowing, 20# of sudan grass (sweet) were drilled into the soil, the theory being that in a summer drought the sudan grass would still be able to make a good growth. Where moisture was plentiful, its growth was not as good as where drier conditions prevailed. Under the theory that sudan grass would make a rapid growth utilizing and storing some of the nitrogen fixed by the legume crop, and that it further, after being plowed down, would retain some of the nitrogen in the form of humus, the sudan grass was plowed down around the 1st of August. To make certain that the carbon of the sudan grass decomposed into humus rather than being given off as carbon dioxide gas, 40# of nitrogen in the form of NH_3 were plowed down immediately after the sudan grass was turned under. In this case the attempt was to maintain the proper carbon ratio of one part nitrogen to 12 parts of carbon. Cane was planted in this soil September 15th.

3. Heavy yielding corn was harvested and the crop residue immediately plowed down. Shortly thereafter 40# of nitrogen in the form of NH_3 were injected into the soil and mixed with the corn residue. This land was not planted to cane, but will be planted to corn this, the following spring.

4. This spring, heavy yielding type sorghum is to be planted, fertilized and plowed down in the summer, at which time nitrogen will be added. A check will be made of the humus content, physical condition, etc.

5. Also, thickly planted corn will be harvested early. The grain having a high moisture content will either be dried or used early for feed. Forty pounds of N will be added to the plowed down corn. It is hoped that decomposition will be sufficiently complete so that cane can be properly planted around September 15th. This system appears to have quite a bit of merit. We might at some future date contract our bean acreage while expanding our corn acreage to which we add purchased nitrogen.

Conclusions

If we are to work toward higher and higher yields of cane and sugar per acre, among other things, we must:

1. Provide a deeper and better prepared root bed.

2. Make certain that the cane is provided with adequate and properly balanced amounts of nitrogen, phosphate and potash.

3. Improve the physical make-up of the soil (organic matter content - humus) so that our cane can better stand periods of drought or periods of excessive rain; at the same time providing a reliable means of storing and feeding the required minerals.

4. Bring our poorer lands up to fuller productivity by increasing the organic matter - humus - in these soils.

No steps should be taken that are not economically sound, but to find out what we can do, and at reasonable costs, many further experiments must be conducted, and these take time. It is hoped that newer and better experiments than those listed above can be started soon with ideas and results pooled for the benefit of our industry. Certainly, if we can find economical ways to improve the physical condition of our soils, our efforts will not be in vain.

SUGARCANE PLANTER DEVELOPMENT IN LOUISIANA

By R. M. Ramp, Sr. Agricultural Engineer, Farm Machinery Section, Agricultural Engineering Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

Plans for the construction and field testing of a sugarcane planter for Louisiana conditions were initiated by the Farm Machinery Research Advisory Committee of the American Sugar Cane League at their annual meeting on February 16, 1954. Prior to formulating the planter program, the design of commercial sugarcane planters used in other sugarcane-growing sections of the world were reviewed by the committee. The two types of planters in commercial production are drop planters and cutter-planters.

Drop planters are composed of a furrow opener or plow, a funnel through which seed pieces are dropped by hand, a seed supply hopper, seed covering tools, and operator's seat. All the seed cane is cut to length, stripped, and treated before it is placed in the supply hopper. These machines are usually manufactured as one-row units.

Following the development of the drop planter several cutter-planters were produced and are in commercial use today. The cutter-planter, as the term implies, combines the cutting and planting of the seed piece. The seed stock is fed one cane at a time into a cutter tube where it is cut to the desired length. A variety of methods is used to cut the seed stock depending on the individual design.

In all the areas where drop or cutter-planters are in general use the rate of planting is one line or less, and the length of the seed piece may vary from 9 to 20 inches. At present the average capacity of 5 acres per day is primarily dependent on the human element since each piece of seed stock must be fed into the planting tube by hand.

Following the review of sugarcane planter development in other areas, the committee agreed that none of the present commerical machines would be readily adaptable to Louisiana conditions. They recommended that the Sugarcane Machinery Project personnel of the USDA design and construct a planter to meet the following requirements:
The planter shall be:

1. Capable of opening the planting furrow to the desired depth and width.
2. Capable of handling full length canes with adhering trash and permitting the canes to be cut in half, or 36-inch pieces.
3. Capable of covering the canes.
4. Equipped with a seed hopper of 2 to 2 1/2 ton capacity.
5. Adjustable for planting rates of 2 to 3 lines.

6. Designed for the seed cane to be supplied to the planter by the conventional method. Transfer to be made by hand or hoist.

To assist the Project personnel in constructing and field testing the planter, the American Sugar Cane League, at the recommendation of the Farm Machinery Research Advisory Committee, made available \$2,500 for materials and supplies.

The planter design was completed on May 18 and reviewed and approved by Mr. Walter Godchaux, Mr. J. J. Munson, and Mr. Roland Toups of the Farm Machinery Research Advisory Committee.

The planting machine is a 4-wheel tractor-drawn unit powered by the tractor power-take-off. A tractor equipped with a low-low gear was provided to obtain the required drawbar pull in relation to the forward speed.

Details of construction of the planting machine are illustrated in Figure 1. The planting furrow was opened by a 14-inch hydraulically controlled middle breaker (A) that had the moldboard trimmed to reduce soil movement. This unit was attached directly to the front end of the planting trough (B) comprised of two sides with a flared extension on the upper edge for guiding the canes into the planting furrow. The sides of the trough prevent loose soil from falling into the furrow before the canes are placed.

A free-floating press wheel (C) was provided at the open end of the planting trough to hold the canes in place while they were being cove with soil from the disk hillers (D). In addition, a set of conventional sugarcane choppers (E) were used to complete the covering and bed forming operation. An adjustable V-blade (F) was provided to strike off the bed to the desired coverage. The beds were normally firmed by a rolling operation after planting.

The seed handling mechanism is illustrated by Figure 2. The seed cane was carried in two 37 x 38-inch hoppers, 11 1/2 feet long, located lengthwise on each side of the feed rolls. The seed cane was loaded by hand and placed either horizontally or inclined towards the front of the planter. All the seed cane was hand dropped, one cane at a time, lengthwise into the feed roll hopper (H). The feed rolls (I) are located so as to form the inside wall of the feed hopper. Canes cannot pass from the feed hopper into the planting trough without being carried over the feed roll by the feeder fingers (J). These fingers were made of 1/4 x 1 x 3-inch steel bars welded in a line and radial to the feed roll. As the right hand feed roll (I) is rotated clockwise, the fingers pass upward through slots in the bottom of the feed hopper carrying all the cane and trash over and partially around the roll. A power driven circular saw (K) was located at the middle point of the feed roll to cut the canes as they were moved by the fingers. The cutting operation was done to assist in placing the canes flat in the planting furrow. The point at which the individual canes are cut depends upon the position the canes are dropped into the feed hopper relative to the saw position. Seed canes 42 inches or less in length, if straight, could

be planted without cutting by dropping the canes in the feed hopper on either side of the saw. Two feed rolls were provided to feed the one row to permit staggering the joints and to enable two feeders to operate independently of each other. After the canes are cut by the saw they are released by the fingers and fall into the planting trough located directly beneath the feed rolls.

The desired rate of planting, or lines of cane per row foot, was obtained by varying the speed of the feed roll in relation to the ground speed for a particular length of seed cane. For example, the feed roll speed for 4-foot seed canes planted at a rate of 2 lines and at a ground speed of 1 mph is 22 rpm. In other words, 22 canes must be dropped per minute in each feed hopper to meet the above condition since one cane is fed from each roll per revolution. The rate of feed is directly proportional to either or both the ground speed and the rate of planting and inversely proportional to the length of seed piece. Doubling the length of the seed cane halves the rate of feeding or with a constant rate of feeding the ground speed or planting rate can be doubled. In all the field tests the feed rate was set on the basis of the average length of seed canes. At any particular instant the actual rate of planting varied in relation to the deviation of the cane from the assumed average length. When the seed canes were longer than average, the rate of planting increased in proportion to the additional length.

It was found necessary in the early field trials to replace the four feed chains with the feed rolls already described. Trash accumulated on the feed chains, preventing the free dropping of the canes into the planting trough and causing chokes. Originally the planter was not equipped with a press wheel, however it was found necessary for holding the canes in place during the covering operation. During the 1954 season 6.2 acres of cane were planted at Godchaux Sugars, Raceland, La., 2.0 acres at Woodlawn Plantation of the South Coast Corporation, and 4.7 acres at St. Delphine Plantation, Cinclare, La. The latter planting was made on flat land in cooperation with Mr. Saveson of the Soil and Water Conservation Research Branch of the USDA.

All the seed cane was loaded by hand except for some of the early field trials. In making the field studies, capacity observations were made on the basis of a row or planter-load. For example, at Ashland Plantation with two feeders it was found that the average planting rate was 12 minutes per .1 acre. In the same area, hand loading time often exceeded actual planting. A representative observation on planting three rows of cane showed that it took 45 minutes to load the seed and only 36 minutes for actual planting. The capacity observations made on St. Delphine Plantation were based on hand loading with four feeders. On October 1, 2.1 acres were planted, including seed loading, in a normal 8-hour day. The following day, 1.5 acres were planted in 4 1/2 hours inclusive of seed loading time.

Observations and Conclusions

1. Mechanical planting will provide a more uniform control of depth of planting and coverage than can be obtained by the present planting

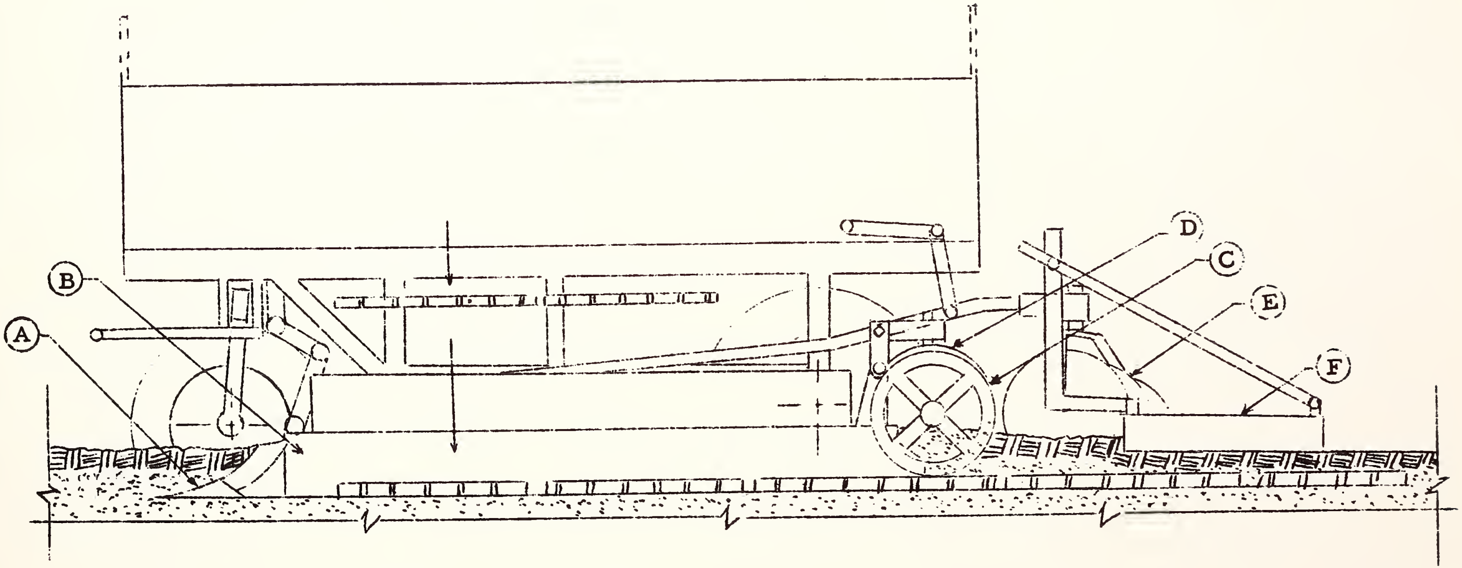


Figure 1. USDA experimental sugarcane planter illustrating construction details (A) Middle breaker, (B) Planting trough, (C) Press wheel, (D) Disk Hiller, (E) Choppers, (F) Striker.

method.

2. With mechanical planting the seed can be confined to a 6 or 7 inch band which will facilitate off-barring and cultivation.

3. Tractor and labor time can be saved by combining the opening, planting, and covering operations.

4. A more uniform placement of seed cane can be obtained by mechanical planting than the conventional method of hand planting.

5. The capacity in acres per day depends upon the condition of the seed cane and the skill and experience of the feeder.

6. The capacity in acres per day can be materially increased by the use of stripped seed cane.

7. To obtain the maximum planter capacity mechanical means are necessary for transferring the seed cane to the planter.

8. The ends of the cane rows cannot be planted satisfactorily with a trailer type planter because of the limited turning space on the normal headland.

9. The planter operator should be located so that he can inspect the seed cane prior to covering.

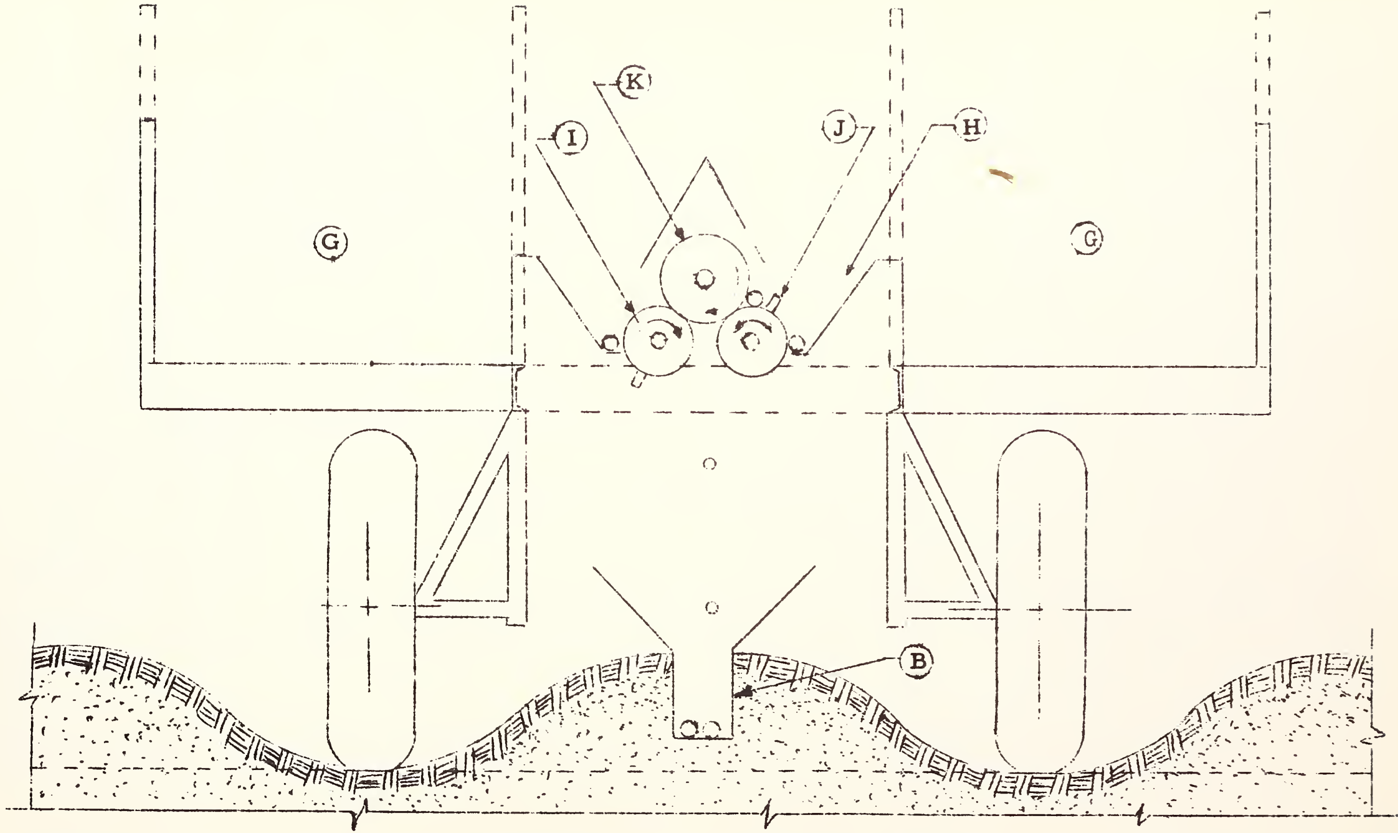


Figure 2. Cross-section view of experimental sugarcane planter illustrating seed cane movement. (B) Planting trough, (G) Seed hopper, (H) Feed roll hopper, (I) Feed roll, (J) Feeder fingers, (K) Circular saw.

STATUS OF SUGAR CANE INSECT PROBLEMS IN LOUISIANA

By A. L. Dugas, Entomologist -- Louisiana Agricultural Experiment Station

Insect pests are causing significant losses annually to the sugarcane crop in Louisiana. An average loss of $9,000,000 would be a conservative estimate of the monetary value of damage to sugarcane stands, growth, cane and sugar yields, and increased costs of production, resulting from the ravages of insects.

The most destructive pests attacking cane in this state are the sugar cane borer; small soil insects and soil animals, including springtails, symphilids, bristletails, centipedes and others; the large soil insects or the sugarcane beetle, the sugarcane weevil and wireworms; aphids that transmit mosaic, and the yellow sugarcane aphid.

An extensive program of sugarcane insect research, conducted for many years by both the State and Federal Stations, has yielded some significant findings. Although much knowledge still remains to be had, there is an excellent opportunity of increasing cane and sugar yields, through the proper utilization of the findings and recommendations emanating from the research to date.

The Sugarcane Borer

The most destructive of all insects attacking sugarcane in Louisiana is the sugarcane borer, *Diatraea saccharalis* (F.). It is estimated that losses from this pest alone amount to about $5,000,000 each year. The relative importance of the insect and the amount of effort and money which should be directed toward its control any one season, is dependent upon the extent and level of the infestation. The borer population that successfully overwinters is the most significant contributing factor to the seriousness of the infestation the ensuing season. It is therefore of considerable value to the industry to receive information on winter carryover of borers in due time to prepare for whatever may be expected. An overwintering population and mortality survey, conducted by the two stations each February furnishes this information.

This borer also attacks rice, regular field corn, sweet corn, sorghum and other small grains. There is some talk of considerable expansion of sweet corn acreage in the cane area. The sugarcane borer would be one of the major problems to reckon with in production of sweet corn.

Present status and outlook for 1955. The general status of the sugarcane borer as a pest of cane and corn has changed considerably in the past three years. A material build-up and general spread of the infestation has resulted from the extensive planting of more susceptible

varieties of cane, and the successful overwintering of large populations of borers the past three consecutive mild winters. Now, the problem is not necessarily confined to localized areas, but it prevalent throughout the cane growing area, both in cane and corn plantings.

The borer outlook for 1955 is quite similar to what it has been the last three years. Following a fourth consecutive mild winter, carryover in both stubble and plant cane fields is extremely high and mortalities are insignificantly low. A partially completed survey of overwintering populations reveal that the average carryover amounts to 1550 per acre in stubble fields with considerable trash, and 1850 per acre in summer and early fall plant. The carryover in plant cane alone is sufficiently heavy to produce a destructive infestation in '55, irrespective of how complete a job is done of destroying borers in stubble fields. From a borer control stand point, it is therefore a good year for shaving of plant cane followed by destruction of shaved-off plants.

Even though the general carryover is high, indicating a possible heavy infestation this season, there will undoubtedly be some rather localized areas where this will not be so, due to a lighter overwintering population, or the beneficial effects of natural enemies and adverse weather conditions during the growing season. This condition was especially evident in '54 in the vicinity of Napoleonville, in Assumption Parish.

Control Program

The accumulated findings of many years of research by various workers, support numerous recommendations which together comprise a borer control program, the only sensible approach to this problem. The basis of such a program is the recommended cultural control practices, which should be adopted on all cane farms. The use of insecticides and the release of borer egg or larval parasites (if and when they are recommended) should then be resorted to where such is justified.

Cultural Control. Cultural control practices are farm operations performed so as to destroy borers or prevent injury. These practices are relatively inexpensive and for the most part recognized good farming methods.

The principal sources of borer infestation in the spring are the sugarcane plant materials left in the field during harvest, including whole stalks and pieces of cane, stunted stalks, green suckers, jointed tops and high cut stubbles. The shoots from summer planted cane and even fall plant may also harbor large populations of overwintering borers. Then the ultimate damage from borers at harvesttime is influenced by normality of growth, opportunities for build-up and spread, harvesting date, and to some extent directly by weather conditions.

Therefore, it is worthwhile to alter cultural practices so that the most good can be accomplished in reducing the number of borers that successfully overwinter, in preventing a build-up and spread during the growing season, and in preventing further losses from heavy infestations during harvest.

A series of such practices, some of which are interrelated appear to be necessary for greatest benefits. For this reason, all are listed at this time in order to present the present status and short comings of these cultural control recommendations.

1. Harvest heavily infested cane as soon as possible. It is well to harvest heavily infested cane early to prevent additional losses, and to allow time for breaking stubble lands while the weather is favorable. Also, overwintering mortalities are known to be higher in earlier harvested fields.

2. Cut cane at ground level. Cane should be cut at ground level or just below the ground to reduce the number of borers overwintering in cane stubbles. Sugar production is also increased, since sucrose is highest in the lower joints.

3. Shredding of cane tops during harvesting operation. Shred the tops to reduce the number of borers which overwinter in joints on cane tops, to make scrapping behind the loader easier and more complete, to increase the effectiveness of chopping and wrapping of middles, and to eliminate the need of burning of trash which would allow the return of this organic matter to the soil.

4. Scrapping for field and farm clean-up during harvest. If the tops are shredded the whole stalks and pieces of cane, stunted stalks and green suckers which are not directed into the shredder become the principal source of carryover in stubble fields. It remains, therefore, to scrap all desirable cane and pieces as thoroughly as possible, and to resort to the chopping, wrapping and shaving practices to take care of what is left in the fields. A special scrapping will often yield sufficient cane to pay for the operation in addition to reducing the borer carryover. It is also desirable that all roads, railroads, and factory and derrick grounds be scrapped of all fallen stalks and pieces of cane.

5. Burning of cane residue thoroughly. Thorough burning of the trash is essential, if the tops have not been shredded. This is expected to kill 60 to 70 per cent of the overwintering borers, and makes chopping and wrapping more effective. Reburning is advisable in fields where a large amount of tops escape the first burning.

6. False shaving of certain fields to be kept as stubble. This is an original phraseology for running a shaver or some flexible toothed device over fields as soon as possible after harvesting to knock the pieces, etc. from the top of the rows into the middles and to cut high stubbles to ground level. This would eliminate the source of infestation on top of the rows, thereby making chopping and wrapping a more complete job. It would also eliminate the need of regular shaving in early spring to take care of stubble fields with a large amount of material remaining on top the row or with high cut stubbles.

7. Chopping and wrapping of middles with or without shaving in stubble fields. It has been found that overwintering borers in the cane trash in the middle of the rows are reduced 76 per cent by chopping and pulling the soil back on the row; 84 per cent by wrapping only; 88 per cent by chopping and wrapping; and 92 per cent by shaving and wrapping as

compared to 20 per cent where nothing is done. If false shaving is not d where needed, in many fields the number of borers which remain in cane parts on top the row is sufficient to produce a destructive infestation in t spring regardless of what may be done in the middles. In such cases, sh ing is the only practice which clears the top of the row of cane stalks and pieces and cuts off the stubbles, thereby eliminating overwintering borer from the top of the row nearly 100 per cent. Chopping and wrapping accounts for only about a 24 per cent reduction of the top row population thr knocking down of some of the stalks, pieces and suckers.

8. Shave heavily infested summer plant or fall plant and dest plants by burning and wrapping. Shaving is the only known practice to destroy heavy populations of overwintering borers in shoots of summer plant or early fall plant. If shaving is not desired in such cases, then insectici later on will undoubtedly be needed.

9. Start spring cultivation in fields most heavily infested the previous year. Early cultivation will destroy many overwintering borers before the adult moths begin to emerge in the spring.

10. Concentrate corn plantings and isolate the plantings where possible. Corn can be a source of heavy reinfestation for dusted cane. Co centrated plantings facilitate dusting and reduce the extent of spread of borers.

11. Plant borer-free cane. Heavily bored seed cane often produces poor stands and lower yields of cane, especially when planted late o under dry soil conditions.

12. Plant the more borer resistant varieties in usual bad borer areas. The need for commercial resistant varieties is keenly felt.

13. Fall break stubble fields. Make a special effort to break stubble land in the fall or early spring. This almost completely destroys all overwintering materials and eliminates these fields as a source of spring infestation.

Insecticide Control. If the beginning of a destructive borer infestation becomes evident during the growing period, then there is no choice but to resort to the use of insecticides.

Chemical control, or dusting with ryania or cryolite in this case, is an immediate control for an infestation that is sufficiently heavy to do damage in excess of the cost of the insecticidal applications. It has no equal or alternative for the specific purpose for which it is recommende Insecticides are recommended only where the proper checking of fields reveals the borer infestation in a general area to be sufficiently heavy to justi the expenditure. Furthermore, it should be done right or not at all.

Dusting with ryania or cryolite is an accepted practice, and is the result of many years of investigations by both experiment stations. As newly introduced insecticides become available, they are thoroughly tested against the borer in an effort to obtain cheaper and perhaps more effective materials. The choice of insecticides is limited because of their injurious effect upon natural enemies of this insect. This has been especially true with regards to the many organic poisons such as toxaphene, BHC, lindane,

dieldrin, etc.

Results of many tests, show that cryolite and ryania are equally effective against the first generation, but ryania is superior for control of the second and the third generations. It must be remembered that the new 70 per cent cryolite, must be used at higher dosage rates than regular undiluted cryolite or 40 per cent ryania.

A knowledge of the habits of the borer and the nature of cane growth revealed the apparent need of an early season poisoning program because of the clearly defined nature of the first and second generation and the advantages in treating the small cane. In most years, there are no joints on the plant at the time of first generation attack, so the protection of the plant is of no economic value. First generation control is therefore a preventive type, however, its value lies in the fact that it reduces early infestation thereby decreasing succeeding generations which actually do the damage. Benefits at harvest time depend upon a near complete destruction of the first generation over a sufficiently large area to prevent reinfestation by later generations. It is therefore necessary that a large part of the infested area be treated so as to lessen the likelihood of an influx of moths from adjoining infested fields. For instance, small experimental plots in which a hundred per cent control of the first generation is obtained show no benefits at harvesttime where surrounded by infested cane. Therefore, the general level and distribution of infestation determines whether the chemical control program should start with the first generation or not.

During the period of second generation attack, five to seven joints are formed and its control gives actual protection to joints and benefits that are measurable at harvest time. Although some benefits are lost by injury from reinfestation by later generations, the losses are not in proportion to the percentage of joints bored because the late injury is mostly in the upper joints where losses are less severe. Although outstanding harvest time differences can be demonstrated in small plot second generation tests, more effective control in the end is dependent upon a sufficiently high kill of second generation borers and a minimum of reinfestation.

The long period of time elapsing from the last application of dust until harvest therefore presents certain risks and necessitates near complete treatment of infested areas. The present trend of thought is toward extending the control period nearer to harvest which is now a possibility since some of the newly introduced varieties of cane grow rather openly at the top allowing dusts to better penetrate in later stages of growth. Very definite benefits are obtained from controlling the third generation, especially in small plant cane where damage may sometimes be quite severe. This was clearly demonstrated in '54 in large scale third generation tests, in which the harvest time borer infestation was decreased by 50 per cent with third generation control.

Among the more pertinent considerations in a chemical control program of the borer are the proper checking of fields to determine when and where to dust; proper timing of dust applications; the use of at least the recommended minimum dosage rates and number of applications; proper

application of the insecticide; treatment of general areas and not scattered fields; and wise interpretation of results.

Biological control. Biological control of the borer through the introduction, breeding and release of parasites offers definite possibilities

The egg parasite, Trichogramma sp., is being bred in large numbers for widespread release throughout the cane area. A laboratory for mass rearing was designed and built for this purpose. It has been in operation for two years, the first year 60,000,000 parasites were distributed for field release and last year 365,000,000 were sent out. The capacity of the laboratory has not been further increased, therefore the maximum production remains about 400,000,000, the approximate number that is expected to be made available for release in '55. A memorandum regarding this years production and distribution will be forthcoming in the near future.

Two larval parasites, the Cuban fly, Lixophage diatraeae Towns and the Amazon fly, Metagonistylum minense Towns appear to have much greater possibilities of becoming established and successfully overwintering under the more favorable conditions which exist today. The comparative higher borer infestation during the early part of the growing season, and the heavier winter carryover of borers especially in a much larger and more scattered acreage of unshaved summer-planted cane offer optimum circumstances for parasites.

Approximately 25,000 Cuban and Amazon flies were received by the entomologists of the two stations for various growers and released in many parts of the cane belt in 1954 to study the possibilities of establishment and overwintering under varied conditions. The extent of establishment of these parasites of borer larvae was found to vary considerably. Parasitism ranged from 0 to more than 60 per cent in individual locations. It appears that the level of host population density is perhaps the principal factor involved in the successful establishment of these parasites the year of release, and winter temperatures and prevalence of summer-planted cane would determine the success of carryover.

Small Soil Insects and Soil Animals

Symphilids, springtails, bristletails, centipedes and snails comprise a group of small insects and animals which we now know do significant damage to Louisiana sugar cane. These minute soil arthropods appear in millions per acre, especially in the heavy black cane soils. Since they are so tiny and live mainly underground, seldom are they seen, unless a special effort is made to observe them.

They cause direct injury to sugarcane by gnawing into cane roots and by cutting off root hairs. The wounds resulting from their feeding permit the easy entrance of root rotting organisms. Their injury is much more seve in the heavy more poorly drained, black soils, of which there are more than 200,000 acres in the cane growing area. It is not known whether there is a relationship of these organisms to the recently discovered stunting disease.

Sufficient data is available to support the recommendation of chlordane for treatment of heavy soils planted to sugar cane to control these

soil pests. Chlordane is applied at the rate of 2 pounds of technical material per acre either as a spray or dust. It is applied on the cane seed pieces in the open furrow shortly before covering with soil.

Six years of cooperative field tests by the Louisiana Agricultural Experiment Station and the U.S.D.A. Agricultural Research Service have shown an increase in yield of sugar cane through the use of 2 to 4 pounds of chlordane per acre in 28 out of 30 experiments. The use of a single application of chlordane increased the average yield of plant cane per acre by 2.8 tons in 30 tests. Seven experiments designed to study the carry-over effect of chlordane into the second year after application, revealed an average increase in cane yield of 2.5 tons the first year, and 2.7 tons the second year. These increased yields have not been obtained in the light sandy soils.

From more recent data, it appears that several other insecticides are just as effective or even more so than chlordane. Endrin, isodrin, heptachlor, dieldrin and toxaphene, all appear to have considerable value. Data is being accumulated on dosage rates and formulation differences of these various materials.

Large Soil Insects

Of the larger insects attacking underground parts of sugarcane, wireworms, the sugarcane beetle, and the sugarcane weevil are of most economic importance. These pests are easily visible and the direct damage they cause is characteristic and clearly detectable.

Wireworms. These are yellowish, slender, smooth, wiry worms a half-inch to an inch or more long, which eat out the buds of planted cane and stubble and into young plants below the surface of the ground. These wireworms are the young of a click beetle, certain species of which most everyone has seen. Injury is greatest in the winter months to fall-planted seed cane, when they bore into the eyes and seriously deplete stands and lower the vigor of the plant cane crop which follows.

The known wireworm area is in sandy soils along the Mississippi River in the vicinity of Edgard, in St. John Parish. The level of infestation is quite variable even within a single cut of cane, making it very difficult to outline the whole of the area significantly affected by wireworms. However, it is felt that the acreage involved is considerably more than is realized.

Wireworms are controlled satisfactorily with chlordane, toxaphene or by summer planting. Several newer insecticides have also given excellent control. Although summer planting is a good practical control measure, it is often impossible to plant all cane at that time. So there is a definite place for soil insecticides.

The results of an insecticide test under conditions of a heavy infestation of wireworms shows how destructive this insect can be. The total increase in yield of plant and stubble cane treated with 3 pounds of chlordane per acre over untreated cane amounted to 30.10 tons per acre, and in yield of sugar, 4,457 pounds. Under conditions of a light infestation the same dosage rate of chlordane accounted for a total increase for the two years of 5.65 tons of cane and 789 pounds of sugar. It is suspected that there is a sizeable acreage sufficiently infested with wireworm to yield returns equal

to that shown for the light infestation.

Sugarcane beetle, Eutheola rugiceps (Lec.). The sugarcane beetle infestation has increased considerably the past two years in the sugarcane growing area of the state. It has caused serious damage in certain fields of cane and is much more widely spread than it has been since prior to 1940, when it constituted an economic problem. It causes heavy losses to corn in the upper half of the state, and also attacks rice, and strawberries.

The adult beetle injures the young shoots of sugarcane in the spring by gnawing ragged holes in them just below the surface of the ground usually resulting in a deadheart. The injury kills the shoot, but a sucker usually sprouts from below the injured portion of the plant. However, the injured plants produce less millable cane and much less sugar than the uninjured ones. Extremely heavy injury by the beetle may kill as much as fifty per cent of the original plants and reduce yields by that much.

Spray applications of endrin, isodrin, heptachlor and dieldrin upon the young shoots and the row have given very good control. Much mo[re] needs to be known about the application of insecticides for beetle control, since the problem is on sandy soils, the type of soil where decreased cane yields have resulted from the use of some of the soil insecticides. Howeve[r] a more extensive program of work on control and biology of the sugarcane beetle is planned for this spring.

Other soil insects. The sugarcane weevil, Anacentrinus subnudus Buch, is a small dark brown weevil about 3/8 inch long. The larva is a white legless grub and tunnels below and just above the surface of the ground in seed cane, young plants, and stubs. In some instances, the stubble is riddled with tunnels and the eyes are killed. The larva sometimes hollow out the eyes of cane to form a pupal chamber. Just what the extent of damage by this weevil, no one knows. No doubt, a part of the increased yields received from soil poisons for small arthropods, is due to the suppression of this insect.

The lesser cornstalk borer, Elasmopalpul lignosellus (Zell.), is sometimes found in large numbers, but it is not thought to be of real economic importance as a sugarcane pest in Louisiana. The larva is a slender, greenish worm, with dark brown longitudinal bands, and makes a rapid jerking motion when disturbed. The larva bores into the young cane plants at or below the surface of the ground, killing the young shoot.

A more thorough study of populations of all of these soil insects is underway to determine the prevalence of each and to differentiate and evaluate the injury attributable to the different species.

Insects That Transmit Sugarcane Diseases

Four species of aphids or plant lice are known to carry sugarcane mosaic disease from infected to uninfected plants. Names in order of their abundance in sugarcane fields, they are the rusty plum aphid, Hysteroneura setariae (Thos.), the corn leaf aphid, Aphis maidis (Fitch), the greenbug Toxoptera graminum (Rand.) and the sedge aphid Carolinaia cyperi (Ainslie). The sharp-nosed grain leafhopper, Draeculacephala

portola Ball, is a vector of chlorotic streak disease of sugarcane.

The control of the insect vectors of sugarcane mosaic through the application of insecticides has been under investigation for some time. After testing most available insecticides, it was found that the systemic poison, systox used at the rate of 1 pint in 20 or 30 gallons of water per acre would almost completely erase heavy infestations and remain effective for as long as five weeks. However, no measureable benefits in reduction of the incidence of mosaic have been received. Further discouragement was experienced in discovering that residues of systox were present in the juice and sugar from systox treated cane. There is need of further investigations to obtain data on the newer systemic materials as well as other types of insecticides.

It is realized that this is only a brief analysis of the present status of the insect problems of sugarcane in Louisiana. Perhaps a more detailed analysis would be advantageous in ascertaining the distinct phases of the many problems in greatest need of study.

STUDY OF RESULTS OF SUGAR CANE IRRIGATION COSTS AGAINST BENEFITS RECEIVED F. A. GRAUGNARD 1955

By E. H. Graugnard.

Estimated Cost of Irrigation Equipment:

Pump at river	$1,000.00
Pipe from river to pump	100.00
Pipeline over levee	990.00
Field pump	350.00
Gated pipe	750.00
	$3,190.00

It is believed that this equipment should be depreciated over a period of 5 years or an annual depreciation of $638.00. Since this equipment should capable or irrigating 120 acres, the cost of depreciation per acre per yea is $5.31.

The cost per irrigation of the 12 acre plot was estimated as follows:

4 Gal. gas per hr. @ 13¢ for 12 ac.	$ .39 per ac.
Labor - 3 man days @ $9.00 for 12 ac.	2.25 per ac.
Tractor for field pump $1.00 per hr. for 9 hrs. for 12 ac.	.75 per ac.
	$3.39 per ac.

Total cost of irrigation:

3 irrigations @ $3.39	$10.17 per ac.
Depreciation of equipment	5.31 per ac.
	$15.48

The gross return per acre on irrigated land	$249.1
The gross return per acre on test non irrigated land	205.5
Gross profit per acre by irrigation	$ 43.6

Gross profit per acre by irrigating	$43.63
Cost of irrigating per acre	15.48
Net profit per acre by irrigating	$28.15

THE USE OF EXTRAPOL FOR REDUCING SUCROSE LOSSES IN BAGASSE

By Leslie R. Bacon and Joseph V. Otrhalek[1]

INTRODUCTION

Shortly after Extrapol[2] became available as a new material opportunities were secured for its commercial trial as an addition agent to the maceration water for the purpose of reducing the sucrose content of bagasse. Even a small reduction in this wastage would have a very considerable economic value. The results obtained in the first commercial trials were so surprising and so favorable that it was decided to carry out a carefully managed laboratory and field test program.

Extrapol is a special high molecular weight synthetic condensation product of ethylene oxide on a polyoxypropylene base of suitable molecular weight, available in solid flake form. A more complete description will be found toward the end of this paper.

PILOT PLANT STUDIES

During the fall of 1952 a careful test program was carried out at Louisiana State University by Mr. Otrhalek under the supervision of Dr. Arthur G. Keller, Professor of Chemical Engineering and Manager of the Experimental Audubon Sugar Factory, and the senior author. The method used for obtaining the final results was as follows:

APPARATUS AND PROCEDURE

Sucrose extraction tests were made on an experimental mill having three 12-inch-diameter rolls arranged in conventional triangular pattern. Top roll pressure was maintained by hydraulic rams at a fluid pressure of 2400 lbs. per square inch. The mill was driven by a 20 h.p. motor and the rolls revolved at approximately 15 r.p.m. The mill took a one foot wide feed from a slightly inclined trough. Figures 1 and 2 show the mill and the experimental method of applying the maceration water.

The bagasse used for final extraction was taken from the blanket between the second and third mills of the Audubon factory three-mill tandem. One hundred pound lots were heaped on clean floors, loosened up and mixed by repeated heaping and quartering for a period of 10 minutes. Uniform 20-pound samples of the bagasse were then weighed out in two equal parts. Preparatory to maceration water treatment each part was distributed uniformly in a one by five foot feed trough and compressed into a blanket as well as possible by tramping the loose material down. The maceration water, at

[1] Wyandotte Chemicals Corporation, Wyandotte, Michigan

[2] Applications for U. S. and foreign trade mark registrations by Wyandotte Chemicals Corporation pending.

a temperature of $82^{\circ} \pm 5^{\circ}$F. was sprinkled onto the bagasse from a 3-1/2 gallon garden sprinkling can. As the maceration water was added, moving backward from the fore end of the feed, the bagasse was slid forward into the mill with minimum disturbance to simulate normal mill conditions as well as possible.

For each 20 lb. grind the bagasse and the maceration water entering the mill were carefully weighed, and the bagasse and juice leaving the mill were carefully and immediately collected, weighed and homogenized For each such run the bagasse entering and leaving the grind was sampled for moisture and sucrose and the extracted juice was analyzed for sucrose and purity. These data made the computation of weight balances possible on the materials used and on the sucrose contents. Preservatives were adde to the bagasse and juice pending analysis. Standard methods of analysis wer used but with special care in sampling, handling and analysis throughout. In general replicate runs were made for each experimental condition investigated on four different days in order to reflect day to day variance of cane. Duplicate grinds were made each day using plain water and using Extrapol in the water. Duplicate analyses were made on each sample for a daily average, and the averages of the four runs treated by standard statistical methods, applying Student's "t" correction for the small number of samples represented. Table I shows a typical data sheet (Run 22). The results of eight such runs are summarized in Table II.

INTERPRETATION OF TABLE II (FINAL RESULTS)

The data which appear in Table II represent the difference between the average of two grinds using Extrapol in the maceration water and two others using an equal amount of water alone. Variations in the Audubon bagasse from day to day were considerable.

Table II shows that in each of eight runs the use of Extrapol resulted in a definite increase in weight and in percentage of sucrose found in the juice over the control run. The average values for the several quantities represented in the table are shown by $\bar{d}$. When Extrapol was used at the level of 2.8 ppm based on cane (14 ppm in the maceration water) there was an average increase of 0.124% or 0.03031 lbs. sucrose in the juice extracted; when 14 ppm Extrapol was used the average increase was 0.255% or 0.0467 lbs. additional sucrose recovered. These represent positive and significant gains.

Corresponding and confirmatory reductions in the percent sucrose and actual sucrose in the bagasse were similarly found. When Extrapol was used at the level of 2.8 ppm a sucrose reduction of 0.299% or actual sucrose reduction of 0.0602 lbs. was found in the bagasse. When 14 ppm were used the corresponding figures were 0.194% and 0.02985 lbs.

In Runs 19 and 20 no reduction in the percent sucrose in the bagasse was found. The difference in the weights of expressed juice lead to the slight differences in weights of calculated sucrose extracted. It was subsequently established that the cane entering these two runs was abnormal in that it had been frozen. If the abnormal data from Runs 19 and 29 are rejected, the averages of the remaining Runs 21 and 22 (which are shown at the

TABLE I. EFFECT OF EXTRAPOL ON SUCROSE EXTRACTION
(Representative Data Sheet)

RUN 22 - 70 Ppm Extrapol in Maceration Water (14 Ppm, Cane Basis)

	Entering Each Grind	Leaving: Extrapol Grinds 1	Leaving: Extrapol Grinds 2	Leaving: Control Grinds 3	Leaving: Control Grinds 4	Ave. Extrapol Grinds Less Ave. Control Grinds = d
Weight Balance, Lb.						
Bagasse	20	19.00	19.25	19.00	19.00	+ .125
Maceration Water	15					
Juice		15.50	15.50	15.50	15.50	0.00
Total	35	34.50	34.75	34.50	34.50	
Weight (leaving-entering)		- .50	- .25	- .50	- .50	
Total loss in 4 grinds	-1.75					
Bagasse Analytical Data						
% Moisture	59	55	56	56	57	-1.0
% Sucrose	6.95	3.69	3.69	4.12	4.12	- .43
Juice Analytical Data						
% Sucrose		4.33	4.36	3.83	3.83	+ .515
Purity		74.39	74.40	75.65	75.10	- .98
Sucrose Balance, Lb.						
Sucrose in Bagasse	1.3900	.7011	.7103	.7828	.7828	- .0771
Sucrose in Juice		.6712	.6758	.5937	.5937	+ .0798
Total	1.3900	1.3723	1.3861	1.3765	1.3765	
Sucrose (leaving-entering)		- .0177	- .0039	- .0135	- .0135	
Total loss in 4 grinds	- .0486					

TABLE II. EFFECT OF EXTRAPOL ON THE EXTRACTION OF SUCROSE FROM BAGASSE

SUMMARY OF RUNS 15 TO 22

Extrapol (Cane Basis)		Average Extrapol Grinds - Average Control Grinds = d							
		Juice				Bagasse			
		Weight	Sucrose	Sucrose		Weight	Sucrose	Sucrose	Moisture
Ppm	Run	Lb.	Lb.	%	Purity	Lb.	Lb.	%	%
2.8	15	+1.625	+ .06855	+ .165	- .405	-1.375	- .09605	- .32	-3.0
	16	+ .375	+ .0350	+ .145	-1.11	+ .435	- .0830	- .51	-0.5
	17	- .125	+ .00595	+ .065	+ .465	+ .065	- .0135	- .08	+1.5
	18	- .125	+ .01175	+ .12	+ .655	+ .250	- .04825	- .285	0.0
	$\bar{d}$	+ .43	+ .03031	+ .124	- .099	- .156	- .06020	- .299	-0.5
	$s_{\bar{d}}$	.715	.0246	0375	.428	.716	.0321	.153	1.62
	$P_{\bar{d}}$	63%	88%	98.8%	17%	27%	95.2%	95.5%	37%
14.0	19	+ .125	+ .02745	+ .165	-1.165	- .125	- .00475	0.00	- .5
	20	+ .25	+ .01885	+ .085	-1.79	+ .125	+ .0038	0.00	-1.0
	21	+ .375	+ .0607	+ .255	-1.545	+ .375	- .04135	- .345	-1.0
	22	.00	+ .0798	+ .515	- .98	+ .125	- .0771	- .43	-1.0
	$\bar{d}$	+ .188	+ .0467	+ .255	-1.37	+ .125	- .02985	- .194	- .88
	$s_{\bar{d}}$	.140	.0247	.162	.443	.177	.0321	.113	.125
	$P_{\bar{d}}$	90%	95.2%	92.8%	98.7%	69%	79%	81%	> 99%
14.0	21	+ .375	+ .0607	+ .255	-1.545	+ .375	- .04135	- .345	-1.0
	22	.00	+ .0798	+ .515	- .98	+ .125	- .0771	- .43	-1.0
	$\bar{d}$	+ .188	+ .0703	+ .385	-1.26	+ .250	- .0592	- .388	-1.0

bottom of Table I) are very much more favorable and in keeping with the increased amount of Extrapol used. In brief, it appears that a reduction of sucrose content of the bagasse of from 0.30 to 0.39% may be obtainable, depending upon the amount of Extrapol used.*

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* The probabilities that improvements of similar order might be obtained on the average, in repeated experiments, are shown by the quantity $P_{\bar d}$. To ascertain this value it was necessary to compute $s_{\bar d}$. The significance of the various quantities is as follows:

$\bar d$ = Average or arithmetic mean difference between pairs of data from related experiments.

$$\bar d = \frac{\text{Sum of d values}}{N}$$

N = Number of pairs of data (one from each experiment).

$s_{\bar d}$ = Standard deviation of the arithmetic mean differences

$$s_{\bar d} = \left[\frac{\text{Sum } (d-\bar d)^2}{N}\right]^{1/2} = \left(\frac{\text{Sum } d^2}{N} - \bar d^2\right)^{1/2}$$

$P_{\bar d}$ = Probability that observed mean differences will be attained or exceeded in replicate experiments.

It is a property of the normal distribution curve of differences that 68.26 percent of all "d" values will be found within the range $\bar d \pm s_{\bar d}$, 95.46 percent within $\bar d \pm 2\, s_{\bar d}$ and 99.73 percent within $\bar d \pm 3\, s_{\bar d}$.

The normal distribution curve applies reasonably well when a minimum of 30 observations are available.

Since the number of observations available here was small, computation of standard error for small numbers of observations and Student's t were made in obtaining the value of $P_{\bar d}$ from tables.

Reference to the statistical data indicates that on the average we should expect to find differences of the order represented with a high degree of reliability; otherwise stated, the results obtained have a high degree of significance.

The effect of application of Extrapol on purity of the juice extracted remains indeterminate at 2.8 ppm on cane basis used but shows a 1.37% reduction with a high degree of reliability when 14.0 ppm were applied. The effect on moisture content of the bagasse is subject to considerable variation and is not considered significant.

PRELIMINARY MILLING TESTS

The first 14 runs were designed to establish the reliability of the Mill Test Method.

Runs 1 to 4 assessed the combined sampling and analytical errors incurred when homogenized bagasse from the Audubon mill was

divided into four samples, as previously described. A part of each sample was analyzed for sucrose. Table III shows that the range in sucrose content among the samples from each run never exceeded 0.16% sucrose.

TABLE III

REPRODUCIBILITY OF BAGASSE SAMPLING AND SUCROSE ANALYSES

	RUNS 1 TO 4			
Run	1	2	3	4
Sample				
1	6.15	7.31	6.79	6.26
2	6.00	7.21	6.94	6.42
3	6.15	7.31	6.94	6.42
4	6.15	7.31	6.79	6.42
$\bar{x}$ (average value)	6.11	7.29	6.87	6.38
$s_{\bar{x}}$ (standard deviation)*	.0648	.0432	.0750	.0693

* Interpretation similar to that given earlier for $s_{\bar{d}}$.

In Runs 5 and 6 mill tests were made to check the effects of the uniform distribution of maceration water throughout the bagasse sample on analyses of juice and bagasse after milling. Fifteen pounds of maceration water were sprinkled over each 20-pound sample of bagasse (equivalent to 20% maceration on the basis of the cane entering the Audubon mill) and after hand mixing to ensure a uniform wetting the samples were milled. This method of adding maceration water gave very uniform milling results and was used in Run 7.

In Run 7, 2.8 ppm of Extrapol (cane basis) were added to the uniformly distributed maceration water in each of two grinds, leaving the other two grinds as controls. No benefit from the use of Extrapol on the extraction of sucrose from bagasse was seen. The reason for this soon became evident.

In commercial mills the maceration water seldom has sufficient time to uniformly wet through the bagasse as had been carefully arranged in Runs 5, 6 and 7. In Runs 8 to 10 the effect of non-uniform distribution of maceration water was examined. In each run two grinds containing 2.8 ppm Extrapol based on cane and two using plain water were made. The 20 pounds of bagasse to be milled in each grind was compress to an approximate depth of 6 to 8 inches in a two foot diameter tub. Fifteen pounds of maceration water were then sprinkled over the bagasse after which the bagasse was picked up as it lay and was ground. It was observed that the water containing Extrapol tended to penetrate the bagasse in the tube to a greater depth than water alone. The data obtained showed that Extrapol improved the extraction of sucrose from bagasse (Table IV). This experimental approach looked promising and further

refinements were made.

The most serious objection to the procedure lay in the time interval between the addition of maceration water and milling which was still much longer than on commercial mills. To correct this, arrangements were made to add the maceration water to the bagasse just as it entered the mill. Special troughs 5 feet long, 1 foot wide and 6 inches deep were constructed for feeding the bagasse to the mill. Ten pounds of bagasse were compressed from a depth of about four inches to a depth of two inches in each trough. Two troughs of bagasse were fed to each grind. Maceration water (7-1/2 pounds) was sprinkled over the bagasse (10 pounds) as it was being fed to the mill. The sprinkling began at the end of the trough facing the mill. In 15 seconds approximately one-half the length of the bagasse in the trough was sprinkled after which the feed to the mill was started. In the next 15 seconds the remaining half of the trough was sprinkled and the rest of the bagasse fed to the mill. From 3/4 to 1 minute was required to mill one trough.

Before carrying out the final tests which followed this method (Table II), a check of the methods just described was carried out in which the bagasse was treated with water only (Runs 11 -14). Four grinds were made in each. The data are too extensive to be included here but indicated that the method developed should yield satisfactory results from the statistical viewpoint.

FIELD TEST AT THE ST. JAMES SUGAR COOPERATIVE

The favorable results obtained in improved extraction of sucrose from bagasse in the Audubon experiments led to a field test conducted at the St. James Sugar Cooperative, Inc., St. James, Louisiana. This modern plant has a rated capacity of 1600 tons of cane per 24 hours.

The cane is washed, chopped, and then passes through a 17 roll tandem, the rolls of which are four feet wide and 27 inches in diameter.

Normally, dilute juice, then water, are sprayed by fan jets over the bagasse blanket. The maceration juice is supplied from the third, fourth and fifth mills by steam syphons which heat the juice to approximately 140°F. This is applied after the first and second mills, and water after the third and fourth mills. The unheated maceration water is supplied from a house line and the flow is measured by a recording unit.

In the test Extrapol was added to the maceration water at the recording unit. There was sufficient pressure drop across the recorder to operate a Sure Chlor Chlorinator modified to feed a stock solution of Extrapol to the maceration flow. Approximately 8 ppm of Extrapol was added on the basis of the cane entering the mill. The sampling schedule was as follows:

1/2 to 1 hr. - Control samples taken at 5 minute intervals and composited.

1 hr. - Addition of Extrapol started. After 15 minutes samples taken at five minute intervals and

TABLE IV. EFFECT OF EXTRAPOL ON THE EXTRACTION OF SUCRO
FROM BAGASSE

Summary of Runs 8 to 10, Using 20 lb. Audubon Bagasse + 15 lb. Maceration Water, and Extrapol at 2.8 ppm (Cane Basis)

d = Average of Two Extrapol Grinds Less Average of Two Cont Grinds

Run	Juice % Sucrose	Juice Sucrose, Lb.	Juice Purity	Bagasse % Sucrose	Bagasse Sucrose, Lb.
8	+ .265	+ .0711	+ 2.01	- .12	- .061
9	+ .300	+ .0445	+ 4.98	- .185	- .050
10	+ .135	+ .0201	- 1.37	- .24	- .039
$\bar{d}$	+ .23	+ .0452	+ 1.87	- .18	- .050

TABLE V

EFFECT OF EXTRAPOL ON EXTRACTION OF SUCROSE FROM BAGASSE AT THE ST. JAMES SUGAR COOPERATIVE, INC.

	Juice Analyses				Bagasse Analyses	
	Control Runs		Extrapol Runs*		Control Runs	Extrapol Runs
Run	% Sucrose	Purity	% Sucrose	Purity	% Sucrose	% Sucrose
1	11.87	79.66	12.06	80.94	4.50	4.10
2	11.40	77.44	11.95	79.03	3.82	3.82
3	11.18	75.95	11.47	77.92	3.82	3.55
4	11.35	77.58	11.87	77.94	3.82	3.28
5	11.82	78.28	11.90	78.30	3.69	3.28
6	11.40	77.55	11.55	77.52	3.69	3.41
7	11.57	76.83	11.80	77.33	3.96	3.82
8	11.67	78.22	11.67	77.34	4.23	3.55
9	11.65	76.80	11.90	79.02	4.23	3.69
10	12.09	78.51	12.39	80.98	4.37	4.10
11	11.40	77.03	12.46	79.77	4.50	4.10
12	12.43	78.18	12.29	80.17	4.10	4.10
13	11.89	77.71	12.21	76.79	3.82	3.55
14	11.74	79.32	11.84	78.41	3.82	3.28
15	11.92	81.03	11.97	79.48	3.82	3.28
16	11.80	78.61	12.08	77.39	3.82	3.14
$\bar{x}$	11.70	78.04	11.96	78.65	4.00	3.63
$s_{\bar{x}}$	.256	1.435	.384	1.934	.278	.310

	Extrapol Runs ($\bar{x}_1$) - Control Runs ($\bar{x}_2$)		
	Juice		Bagasse
	% Sucrose	Purity	% Sucrose
$\bar{x}_1 - \bar{x}_2$	+ .26	+ .61	- .37
$P_{(\bar{x}_1 - \bar{x}_2)}$	96%	68%	>99%

* 8.1 ± .3 ppm Extrapol added on cane basis to maceration water. The flow of maceration water during each control and Extrapol grind was held constant.

TABLE VI

RESULTS OF USE OF EXTRAPOL AT VALENTINE SUGARS, INC., LOCKPORT, LA.

Bagasse Sample Number		Bagasse Sample Collecting Period	Bagasse Sample Analysis % Sucrose	Bagasse Sample Analysis % Moisture	Maceration Water, % on Cane
1	Dec. 19	12 Noon to 3 P.M.	4.10	49.7	20
2		3 P.M. to 6 P.M.	4.56	51.8	20
		6 P.M. - Start Extrapol			
		6 P.M. to 9 P.M.	4.05	51.9	20
		9 P.M. to 12 Midnight	4.14	50.0	20
		12 Midnight - Stop Extrapol			
5	Dec. 20	12 Midnight to 3 A.M.	4.25	-	20
6		3 A.M. to 6 A.M.	4.30	51.1	20
7		6 A.M. to 9 A.M.	4.66	-	20
8		9 A.M. to 12 Noon	4.44	52.0	20
9		12 Noon to 3 P.M.	4.41	-	15
		3 P.M. - Start Extrapol			
10		3 P.M. to 6 P.M.	3.73	51.0	22
11		6 P.M. to 9 P.M.	3.88	-	22
12		9 P.M. to 12 Midnight	4.27	48.2	22
		12 Midnight - Stop Extrapol			
13	Dec. 21	12 P.M. to 3 A.M.	4.07	-	22

(Continued)

TABLE VI
(Continued)

ANALYSIS OF DATA ON RESIDUAL SUCROSE IN BAGASSE

		Control Period		Extrapol Period		Residual Sucrose Reduction, %
		Sample No.	% Sucrose	Sample No.	% Sucrose	
Dec. 19	Trial	1	4.20	3	4.05	
		2	4.56	4	4.14	
		Average	4.38		4.10	0.28
Dec. 20, 21	Trial*	5	4.25	10	3.73	
		6	4.30	11	3.88	
		7	4.66	12	4.27	
		8	4.44			
		13	4.07			
		Average	4.34		3.96	0.38
		Average residual sucrose reduction by Extrapol				0.33

* Sample No. 9 is omitted because of the abnormally low maceration water flow.

TABLE VII. RESULTS OF TRIAL OF EXTRAPOL AT CENTRAL FRANCISCO

Tandem "A" Prueba Mayo 8/52

Gpo.	Brix	Sac.	Plureza	Dil % Normal	Bagazo Sac.	Hdad
Des.	20.13	16.69	82.91	18.54	4.66	49.70 Sin Producto
Dil.	16.56	13.09	79.04			
Res.	6.53	4.92	75.35			
Des.	18.50	14.45	78.11	18.42	3.98	49.40 Con Producto
Dil.	15.20	11.29	74.28			
Res.	6.20	4.37	70.48			
			Diferencia		0.58	0.30
					.68 ?	

Tandem "B"

Gpo.	Brix	Sac.	Plureza	Dil % Normal	Bagazo Sac.	Hdad
Des.	20.53	16.81	81.88	17.13	3.62	48.76 Sin Producto
Dil.	17.10	13.33	77.95			
Res.	6.20	4.60	74.19			
Des.	20.40	16.74	82.06	17.05	3.38	48.46 Con Producto
Dil.	17.00	13.31	78.27			
Res.	5.60	4.17	74.46			
			Diferencia		0.34	0.30
					.24 ?	

TABLE VII (Continued)

	Gpo.	Brix	Sac.	Plureza	Dil % Normal	Bagazo Sac.	Hdad
Tandem "A" Prueba Mayo 9/52							
	Des.	20.37	16.81	82.52	16.61	4.58	49.60 Sin Producto
	Dil.	17.04	13.42	78.76			
	Res.	7.23	5.43	75.18			
	Des.	20.10	16.56	82.39	19.51	3.93	49.17 Con Producto
	Dil.	16.40	12.88	78.54			
	Res.	6.90	5.16	74.78			
				Diferencia		0.65	0.43
Tandem "B"							
	Des.	20.73	17.28	83.26	19.70	3.77	48.60 Sin Producto
	Dil.	16.90	13.45	79.59			
	Res.	6.10	4.62	75.73			
	Des.	20.30	16.90	83.25	15.12	3.41	48.20 Con Producto
	Dil.	17.20	13.64	79.30			
	Res.	6.00	4.53	75.50			
				Diferencia		0.36	0.40

Summary (by authors)

Average Results of Four Trials		Range
Sucrose reduction in bagasse	0.48%	0.24 - 0.68%
Moisture reduction in bagasse	0.36%	0.30 - 0.43

composited.

1 hr. - Flush period; no samples taken

3 hr. - Time required for each cycle

The 3-hour cycle was repeated four times each test day. Runs were made on December 11, 12, 13 and 15 for a total of 16 Extrapol runs, with controls. The data appear in Table V.

The conditions at St. James under which these tests had to be made were abnormal in that the cane ground exceeded the evaporator capacity of the house and consequently the maceration water had been reduced in order to handle the juice load. During the test period approximately 100 tons of cane were ground per hour which is 50% over the rated capacity. The average Maceration % Cane for the season was 17.07%. The average figure during the test period was 12.28% (range 10.31 to 14.75%.)

FIELD TEST AT VALENTINE SUGAR, INC., LOCKPORT, LA.

During the late season of 1953 a brief trial of Extrapol was carried on at Valentine Sugar, Inc., Lockport, La. This mill has a rated capacity of 2,300 tons cane per 24 hours. The 7-foot wide tandem include two sets of revolving cane knives, a two-roll crusher and three 3-roll mills. Cold maceration water is added between the second and third mills and a part of the juice from the third mill is returned as maceration juice to the cane leaving the first mill. Extrapol was injected from a stock solution into the maceration water by a Du-Self Chlor-O-Feeder made by Proportioneers, Inc., Providence, R.I.

During the period of test the maceration water was held at approximately 20% and the operating conditions were quite uniform. During this period residual sucrose in the bagasse was running unusually high in all Louisiana mills.* The data obtained appear in Table VI.

FIELD TESTS OF EXTRAPOL IN CUBAN MILLS

The original field trials of Extrapol were made in Cuba in the spring of 1952 by the factory personnel of Central Florida and Central Fancisco, Camaguey Province.** The application recommended was 14 ppm or 350 pounds per million arrobas of cane). Only the final results furnished by the Centrals are available. At Central Florida the test was of 8 hours duration with and without the application of Extrapol in the maceration water. Samples were taken at 3 hour intervals. The results show:

	Sucrose, %
Bagasse, without use of Extrapol	3.84 and 3.94
Bagasse treated with Extrapol	3.55
Average reduction of sucrose	0.34

* Frequent rains during the campaign had resulted in bringing much soil into the mills on the cane which had ground down the grooves of the mill rolls, leading to slippage and poor extraction according to Dr. A. G. Keller.

** Arrangements for the trials were made by Sr. Armulfo Arroyo, representing Wyandotte Chemicals Corp. and Casa Turull of Havana, Cuba.

These data are available through the courtesy of Sr. Crespo Glez and Mr. A. G. Walsh of Florida Industrial Corporation of New York.

At Central Francisco trial Extrapol runs were made on two days. We are indebted to Chief Chemist J. C. Torres for the data of Table VII.

PROPERTIES OF EXTRAPOL

Extrapol is a special condensation product of ethylene oxide on a polyoxypropylene base of suitable molecular weight, manufactured by Wyandotte Chemicals Corporation under U. S. Patent 2,674,619. It is a free-flowing white flaked product of melting point 50°C. (122°F.) minimum and neutral in reaction. The product is extremely stable chemically, resisting the action of boiling 10% sulfuric acid or 25% caustic soda solutions for at least 15 minutes. It is compatible with surface active agents of all types and most other materials, either in solution or in dry state. The product does not have well defined solubility limits but 20% solutions can be made at room temperature without great difficulty. Solutions remain clear in hard or soft water up to the boiling point.

Extrapol is almost tasteless and relatively harmless and non-toxic. Extensive toxicity tests indicate that the LD_{50} for oral toxicity toward five species of animals is greater than 15 grams per kilogram of body weight when given in single doses. No symptoms of toxicity were revealed by the growth pattern, biochemical or hematological changes of histopathological examination of the tissues of rats fed with food containing 3 or 5% of Extrapol for periods of six months. Additional data are available on intravenous and intraperitoneal toxicity, hemolysis of human blood cells, eye, gum and skin irritation and skin sensitization, all of which point to unusual freedom from toxic effects.

Extrapol may be handled in conventional equipment without fear of enhanced corrosion or difficulties. The several forms of rubbers and plastics as used in the Precision Model S feeder have been determined to be very little affected by Extrapol solutions and the parts may be easily renewed if needed.

Under favorable conditions Extrapol may generate considerable foam but such foams are not very stable, especially in the presence of oils or hard water ions. Ten percent solutions show a surface tension in the neighborhood of 40 dynes/cm. but the dilute solution applied to the bagasse will have surface tensions in the range 55-45 dynes/cm., depending on strength used. The surface tension is reduced somewhat as the temperature is increased.

METHODS OF FEEDING EXTRAPOL

Up to this time Extrapol has been used at levels from 8 to 14 ppm based on cane. At a 20% maceration level the actual concentrations as applied would be five-fold or 40 to 70 ppm. These are obtained by dissolving the white flakes in a clean water supply to yield a stock solution of approximately 10% or 100,000 ppm concentration. This solution is fed into the maceration water line in the right proportions, which range from 1 part stock solution per 2500 of water to 1 part per 1400 of water.

It is recommended that the concentration of Extrapol solution should not be increased materially above 10% as the material goes into solution more slowly as the concentration increases. The solution should be agitated to insure that all the material goes into solution but this must be done with care to minimize foaming. Foaming has not caused any trouble at use levels. Slight foaming is seen as the treated maceration water strikes the bagasse, and this may be used as an indication of whether the unit is feeding or not.

The stock solution may be fed into the maceration water line in any suitable way but best by the use of positive displacement proportioning pumps. The Precision Machine Company's Model S single pump head feeder may be recommended or the Model S double head feeder where a larger flow is required. The latter may be arranged to feed separate tandems if the requirements are within the capacity limits. This pump is small, economical and simple to install. Such an installation is shown in Figure 3, and a photograph of the Model S single head pump is shown in Figure 4.

Other proportioning feeders capable of equal performance may be used. A Wallace and Tiernan Chlor-O-Feeder capable of delivering four times as much solution has been so used (Fig. 5). This feeder could probably meet the Extrapol demand of even the largest mill.

Proportioning feeders which depend upon differential pressure injection principles have been used but with less success. The needle valve controls usually associated are somewhat subject to fouling and require frequent checking or cleaning. Dust, bagasse and all forms of dirt must be kept out of the stock solution in any case. A booster pump usually must be installed ahead of the proportioning feeder to maintain the pressure differential necessary for reliable operation, because of the extremely wide variations observed in house line pressures. The cost of a soundly engineered proportioning feeder is very small in relation to the benefits gained by reliable and carefree operation.

DISCUSSION

FIELD TESTING PROBLEMS

It is very difficult to set up a mill test program involving small changes in practice (such as the introduction of Extrapol into the maceration water) which will yield incontravertible results. In the light of the extremely small amounts of Extrapol used, the early results obtained seemed most surprising and gratifying but quite open to question. Precisely this view led to the carefully controlled work at Louisiana State University. Although these experiments could not exactly duplicate commercial mill conditions, a close approach was made, the results fell in line with previous indications, and the work was followed by further milling tests in three plants. In only one plant trial among five did the results fail to show definite economic benefits (see next section). There appears to be ample justification for

disqualifying this one test run for the following reasons:

1. Variability of Cane. This test was conducted in two parts, the first being supervised and the second unsupervised. During the first period Extrapol showed average benefits somewhat above the break even level, but one must discount the results heavily because of very wide variances in the sucrose content of the bagasse, whether Extrapol was being applied or not. This may have resulted in part from variations in cane near the end of the campaign following an extremely wet and difficult season.

2. Bagasse Sampling Program. Cane normally was ground as delivered to the mill but during the night stocks were taken from storage piles of variable history and quality. During the supervised test the control periods and Extrapol operating periods were randomized around the clock, but during the unsupervised period, the daily control and the Extrapol treatment periods followed a uniform clock schedule. Night and day differences in the cane used and perhaps also in personnel and operating conditions confuse the issue.

3. Improper Distribution of Maceration Water. In the Audubon experiments it was noted that maceration water containing Extrapol tended to penetrate more deeply through the blankets than the plain water. Additional special experiments were run which tended to support this view. It is also notable that after sprinkling bagasse with water containing Extrapol and tumbling to effect uniform distribution, no benefits were indicated over the use of plain water. It is concluded from this, and observations of mill practice, that the maceration water as commonly flowed or sprayed over the bagasse fails to penetrate the blankets completely within the few seconds before final extraction. Extrapol should offer its greatest advantages when applied to mills which operate under such conditions. It cannot promise benefits where the bagasse fails to receive treatment or where localized excesses of maceration water are applied. This factor undoubtedly contributed to the poor showing of Extrapol in the one plant. Some strips of the blanket were not contacted at all while others received excessive flows, so that penetration of the blanket should have been complete, locally. In most of the factory experiments the tests had to be improvised during or toward the end of the campaign, without opportunities to correct adverse conditions sometimes found.

ECONOMIC BENEFITS

Table VIII summarizes the results obtained from the use of Extrapol in four plant trials and the two carefully controlled non-plant trials. The reduction of sucrose in bagasse has ranged from 0.30 to 0.48%. Significant increases in actual sucrose recovered in the juice show confirmatory indications where data are available. Sufficient data are available from the Audubon and St. James experiments to compute the probabilities with which such savings might be expected from repeated experiments under similar conditions. These probabilities are high and the results therefore very significant.

TABLE VIII. SUMMARY OF RESULTS OBTAINED FROM EXPERIMENTAL TRIALS OF EXTRAPOL

Trial at	Extrapol Used (Ppm on Cane Basis)	Sucrose Increase In Juice, %	Sucrose Decrease In Bagasse, %	Probability of Obtaining Indicated Sucrose Benefits Repeatedly	
				In Juice	In Bagasse
Central Florida, Cuba	14	-	.34		
Central Francisco, Cuba	14	-	.48		
St. James Cooperative, La.	8.1	.26*	.37	96	> 99
Valentine Sugars, Inc., La.	11	-	.33	-	
Audubon Sugar Factory, La.	2.8	.124 ≁	.30-	98.8	95.5
Experimentation	14	.385 ≁ ≠	.39-	-	

* Mixed Juice

≁ Final Mill Juice

≠ Data from frozen cane omitted

Such improved recovery of sucrose should be very attractive to management as the following calculations will indicate. Cuban conditions are assumed.

Assumptions

1. 14 ppm Extrapol added (cane basis)
2. Use of Extrapol reduces sucrose content of bagasse by 0.30%.
3. Cane yields 26% bagasse (Cuba) or 32% (Louisiana).
4. 90% of the increased sucrose in the juice is recovered as raw sugar.
5. Raw sugar normal value 4¢/lb.
6. Extrapol cost to mill 90¢/lb.

Calculations

		Per Ton of Cane
Value of sugar gained:	2000 x .26 x 0.003 x .9 x .04 =	$0.05616
Cost of Extrapol used:	2000 x .000014 x 0.90 =	0.02520
Net gain per short ton of cane ground		0.03096

The benefits from the use of Extrapol in a typical Cuban mill which grinds 500,000 tons of cane per campaign are suggested by the following table:

Assumed Additional Recovery of Sucrose From Bagasse, Percent	Net Value Per Ton	Value For 500,000 Tons
0.135 - Break-even point	$0.00000	$ 0,000
0.20	.01224	6,120
0.30	.03096	15,480
0.35	.04032	20,160
0.40	.04968	24,840
0.50	.06840	34,200

From these gross profits small charges for feeding installation costs, regulation and servicing the feeder and for processing the additional sucrose recovered would have to be deducted. It is also recognized that various arrangements exist under which increased profits are shared between the sugar factory and its cane growers.

Under United States conditions where the net cost of Extrapol would be slightly less and the percentage of bagasse and the price of raw sugar slightly higher, a lower break-even point is indicated, close to 0.10% additional recovery of sucrose from bagasse.

OTHER BENEFITS AVAILABLE FROM THE USE OF EXTRAPOL

Aside, first from making possible the recovery of more sucrose from the cane without increased use of maceration water, whereby plant income and efficiency may be increased, there are other opportunities for service which Extrapol can fulfill excellently. All arise from the impracticability of using sufficient water to wet out the bagasse blanket thoroughly.

Second: Minimum Investment in Plant.

Obviously, for a given output of raw sugar it is advantageous to produce mixed juice as high in sucrose content as possible to minimize the volumes to be processed. This will be reflected directly in smaller necessary investments in subsequent liming tanks, heaters, clarifiers, evaporators and direct operating charges. In terms of milling equipment the increased recovery of sucrose available through the use of Extrapol may be equal to the benefits resulting from lengthening the tandem by another mill, the capital costs of which may run to $100,000.

Third: Increased Flexibility of Operation.

Many factories are limited in grinding capacity by bottle necks in clarification or evaporation capacity. In such cases, without sacrifice in increased losses of sucrose to the bagasse, the use of Extrapol permits the percent maceration to be cut down and throughput increased. The St. James test was run under precisely these conditions at season's end, operating at 50% overrun of rated milling capacity.

OTHER OPERATING CONSIDERATIONS

It is felt that Extrapol should be introduced just ahead of the final extraction rolls rather than at any earlier stage. Since it is common to recycle dilute juice from the final mill as maceration juice this automatically carries Extrapol to the earlier extraction stages where added benefits may be derived.

One may suppose that other materials as well as sucrose may be solubilized or peptized leading to reduced purity. Some of the data available suggest an increased and some a decreased purity, about equally divided. There is no indication that this need be a matter of serious concern.

No evidence of any effects on clarification or filtration characteristics, on scale formation or foaming in evaporators, or on crystal initiation or growth have been noted. In many cases the application of Extrapol was for rather short periods but in some cases sufficiently continuous and prolonged that the lack of adverse effects may be given some weight.

CONCLUSIONS

1. Four factory trials of the addition of Extrapol to maceration waters indicate sucrose reductions in bagasse ranging from 0.33 to 0.48% sucrose. The increased extraction efficiency appears to be roughly equal to the effect of addition of another mill to the tandem.

2. One supervised factory test yielded data suitable for statistical treatment which indicates a reduction of 0.37% sucrose with a very high probability that equal benefits would result from tests under similar conditions, on the average. The sucrose was shown to be recovered in the juice extracted.

3. Carefully conducted work on a pilot plant basis has shown sucrose reductions of 0.30 and 0.39% in the bagasse, and corresponding recovery of the sucrose in the juice.

4. No clear relation is yet established between the concentration of Extrapol used and sucrose recovery. Pilot plant experiments suggest that as little as 2.8 ppm (cane basis) will show appreciable benefits.

Levels within the past range of factory experimentation - 8 to 14 ppm, cane basis - are recommended for the present. The data are insufficient to establish optimum concentrations, which may be higher than 14 ppm.

5. At the break-even point under normal Cuban conditions the application of 14 ppm Extrapol corresponds to a reduction of sucrose in the bagasse by approximately 0.135% below that obtained in normal practice. Under Louisiana conditions the break-even point lies in the vicinity of 0.10%.

6. The potential saving resulting from the use of Extrapol in a Cuban mill grinding 500,000 tons of cane appears to be upward of $15,000 per year, based on reduction of sucrose in bagasse by 0.3%. For each additional 0.1% reduction an added saving of $9,360 is indicated.

7. Extrapol is best fed into the maceration water by a positive displacement proportioning pump. The 10% solution should be fed into the distribution lines to the final one or two mills.

8. The extremely low toxicity of Extrapol coupled with its demonstrated performance at a very low concentrations qualifies it uniquely for the indicated service.

REVOLVING CANE KNIFE DISCUSSION

By M. V. Yarbrough, Moderator

You have been handed topic outlines so that this discussion may be brief and still cover the various points consecutively. It's now quarter after five, pm, and we have 7 different topics to be discussed. We will merely take the topics and request that each of the members of the panel here try to outline two things; in their own experience what they feel and have found to be the best practice, and second their reasons. After each gentleman has covered those two points with respect to each of these topics we would like to discuss each of them and permit discussions or questions from the floor which I am sure the members of the panel will be glad to try and asnwer.

First the section of the blades themselves, the material from which the blades are made, the length of blade projection from the hub, the shaping and sharpening, surfacing and the method of attachment to the hubs.

Mr. J. E. McNamara:

In our case we use mild steel. Our blades are 19 3/4" long. They are forged out to give a curve on the end and only the cutting edge is hard surfaced. We've had very good results using mild steel. Several years ago we went to a better grade of steel and placed borium on the cutting surface. After the borium on the cutting surface wore out, the Lancaster steel didn't last any longer than the mild steel. Since the Lancaster steel was costing us about 3 times as much as the mild steel, we went back to mild steel. Our practice is to try to use these blades to the best advantage. It just happens that we run anywhere from 15-18 days between wash-outs, and we take advantage of the time we are down for the washout to change our blades. We've been getting for the past couple of years anywhere from 26-28 thousand tons of cane on one set of blades. There are 32 blades on our knife shaft which is a Nadler heavy duty type, and the carrier is 78 inches wide. We use one single bolt for attachment to the hub an 1 1/2" bolt, 3 1/2" long, 12 threads to the inch. This bolt is made of Tx4140 alloy hot rolled steel, heat treated, after all machine work is completed. We find that this bolt holds up much better than the standard bolt and having 12 threads to the inch found that the nut doesn't loosen up as badly as the standard bolt.

Mr. Wainwright:

We found the best material to be mild steel, sharpened on one side and surfaced with Resistaloid on the straight face. Our blades project 12 to 14 inches from the hub. They are attached with 2 bolts and 1 bolt.

Mr. D. C. Bolin:

Our blades are made of mild steel. Our blades are of a different shape, they are something on the order of a double edged Gillette razor blade. They were furnished by Farrel when they built our factory. They are attached with three bolts at an angle to the shaft (30 degree) and have 4 cutting edges. Each of those edges is used between the washout periods which is usually two weeks. We change the edge each time we shut down. Usually we make a whole season with one set of knife blades. When we finish with all four of these edges, the knife is no good any more. We don't try to re-sharpen it. We change the knives at the beginning of the next season. The length of the blade as it projects from the center of the shaft to the tip of the blade is around 30 inches. The hubs themselves are about half that amount. The blade sits on at an angle. We don't do any sharpening of the blades, there is nothing left to sharpen. We use borium for surfacing and we surface the blade on both sides. We have had no luck by surfacing it on one side only. They are attached to the hub with 3 bolts 7/8" bolts by 3 1/2". They are actually not bolts, we found that the bolt head would break, so we use stud bolts now with nuts on both ends, and they don't break.

Mr. J. T. Landry, Jr.

Our blades are made out of boiler plate at two of our places. Boiler plate is just about the same as mild steel. We use borium to tip the blades at two mills and one uses Stellite. Also two of our plants tip the flat straight edge and one plant tips the bevelled edge. These knives are all cut out of a sheet steel and are not forged. They are cut, shaped and bevelled with the torch and then hard surfaced. Our blades project 8-12 inches from the hub. They are attached with only one bolt. Our bolt sizes vary from 1" to 1 1/2" the middle one is 1 1/8". We are not standard at all in that respect.

Mr. Yarbrough:

Primary Knife Assembly--In the case of factories which have only one set of knives that would be it, in cases of factories having two sets of knives that would be the first set that knifes the cane.

Mr. McNamara:

We come in the category of having only one set of knives. The outside diameter tip to tip of blades is about 36". The blades are set about an inch from the carrier and the holder is a double holder so that would be about 36". Out set is located at the carrier just at the point of incline; having only one carrier that would be right at the point of inclination of the carrier. Our knives run at a speed of 550 RPM. The set of knives is driven by a 300 HP turbine, Morris type, geared turbine. The speed of the turbine is 3618 RPM reduced down to 550 RPM. Speaking of the life expectance of the blades, we use a new set of blades, put borium on the cutting edge. They are reconditioned and the borium replaced if necessary. We are able to get close to 50 thousand tons of

cane with one set of blades which have been reconditioned once. We have no secondary knives.

Mr. Wainwright:

We only have primary knives on both of our tandems at Raceland. The outside diameter tip to tip of blades is about 5'. Location on the carrier about 6' from the carrier break on the incline. Speed about 500 to 550 RPM. Our power requirement is a little low. We don't run with a full set of knives any more. We operated with 30 knives on the seven foot carrier and 30 on the 6 foot carrier. The power we have available is about 300 HP on the 7' tandem and 250 HP on the 6' tandem, which was ample when the knives were installed in 1933. But today we are short. We get 4 weeks with our blades before we take them out to resharpen. We found that Resistoloid lasts a lot longer than borium. We get about two sharpenings from a set of knives. We can draw them out and forge them out and get 2 sharpenings, so that they will come down to within 1/2" of the carrier.

Mr. Bolin:

We have two sets of knives. They are both the same size and shape, the outside diameter which is 5'. The first set of knives is at the head of the first carrier and the second set is located on the lower part of the second carrier about 8' ahead of the first one. Our knives are directly connected to a motor. The speed of the motor is 580 RPM. Our motor on the primary knives is 150 HP, which is not quite enough, should be about 200 HP. The one on the second set of knives is a 200 HP motor, and it should be about 50 HP more. We don't recondition our blades. We just wear them out. We get about 25-30 thousand tons of cane on each cutting edge. We change the cutting edge about 4 times during the grinding season.

Mr. Landry:

Our knives are about 4 1/2 to 5" in diameter, that goes for all of them. They are all on the inclined section of the carrier. At our three mills we have our carrier broken. The horizontal sections run under the feeder table. That section of the carrier delivers cane to the inclined carrier. Our knives are located on this inclined carrier. The speed is between 500-550 RPM varying at different places. At Oaklawn we grind 3200 tons. There we have a 300 HP turbine. At Terrebonne where we grind about 2800 tons we have 275 HP. At Georgia we grind about 2000 tons. We have a 210 HP, 125# steam pressure turbine hooked into a 250# line. We are getting a good deal more than 210 HP there. The life expectancy at Georgia, they get a great deal more than anyone else, I think that is because they have a little more power on their knives. They will go anywhere from 80 thousand tons to the end of the crop. When they get through with the knives, they take them off and throw them away. They don't try to recondition them. At Terrebonne we get about 30 thousand tons from a set of knives. They are taken off reforged and resharpened. At Oaklawn they get from 40 to 50 thousand. They are resharpened but with the torch. Oaklawn knives are not forged to be reconditioned.

Oaklawn and Terrebonne can usually make the crop with two sets of knives, Georgia can make it with a set or a set and a half.

Mr. Yarbrough:

A question about the location of the knife sets in the carrier: I hope that it will not be obnoxious of me to relate my experiences in our own plant. We are handicapped by having to carry not more than 125# of steam pressure on account of pipe lines, not boilers. We have all of the steam that we want, pipe lines are adequate. We have to carry about 14 to 15# of exhaust pressure at the knives themselves which is not excessive. Through the years we have had the conventional 2 cylinder upright steam engine direct connected to the knives. I will say that that is a magnificant drive for knives if it has adequate power. For many years we had those knives located some 6 or 8 feet up the incline in a single carrier and we were continually bothered with knife chokes. When grinding possible 50-60 tons of cane an hour we simply could not do a good knifing job. We didn't have enough power. Some 4 or 5 years ago we split our carrier as Mr. Bolin has outlined. We located the same knives driven by the same drive movement at the end of the incline carrier. We have had many cards on that engine, and it cannot possibly develop more than about 135 HP at 550 RPM. We are now grinding 1800 to 1850 tons of cane a day and we are unable to choke our knives. The only change is the location of the knives on the carrier. I will say incidently, that we have to keep these knives away from the carrier at that point to avoid knifing more finely than we want the cane knifed. Because in grinding Co. 290 cane there is a point beyond which we cannot go in fineness. We have to maintain a clearance here of about 2 or 2 1/2" and we largely split the cane rather than tear it to pieces and I would say that 9 tenths of the stalks are cut in lengths some 8-10" long and they are split into two or three pieces lengthwise which is a great assistance in getting the juice out of the crusher.

Shaft Carrying Knife Hubs or Holders:

Mr. McNamara:

The diameter of our shaft is 4 15/16" made of nickel steel, and the distance between the bearings is 9'. The type of bearings we have are 4 15/16" Dodge Timken roller bearings, ball and socket pillow block Dt#175 cast iron housing.

Mr. Wainwright:

On our 7' tandem we have a 8" diameter FA 10-18 shaft with spherical roller bearing. Center distance about 9'6". On our small tandem we have a 4 15/16" shaft with babbitted self-aligning pillow block with bearings 4 15/16" by about 16" long not water cooled, center distance 9'6".

Mr. Bolin:

On both of our knives we have the same diameter of shaft 6 1/2". It is a cold rolled shaft and the distance between the bearings is 8'. The type of bearing is an oil ring pillow block bearing, babbitted both the same type.

Mr. Landry:

We have at 2 of our mills 5 7/16" shaft, (no specifications on the type of steel we use). At the other we have 5 15/16". Our bearings are all SKF heavy duty roller bearing. Our distance between 8 and 9' at the various mills.

Type of Drive:

Mr. McNamara:

Our 300 HP turbine is direct connected to the knife shaft and we use a #15 standard type coupling. All going into the shaft they have a 42" by 8" balancing wheel.

Mr. Wainwright:

At Raceland we have a V-flat-belt drive.

Mr. Bolin:

Ours are directly connected to electric motors.

Mr. Landry:

In our case we ar- driven by steam turbines through a reduction gear. The reduction gear is directly connected to the shaft.

Mr. Yarbrough:

I had hoped to have time for a general discussion lead by the panel of this subject which I think is very controversial depending upon capacity, type of milling equipment and amount of maceration used and what have you; but due to the lack of time I would like to confine it to an expression of the personal views of th each of the four panel members with respect to the degree of fineness to which you would like to have your cane knifed for the best results both with respect to milling capacity and efficiency.

Mr. McNamara:

One thing we know about the fineness of knifed cane. When you have a new set of knives you get a finely divided cane and the crusher has a tendency to choke. After a period of a couple of days or so the fineness becomes less and the crusher seems to feed better. It has always been our policy to try to get to a happy medium, a sort of semicoarse.

Mr. Wainwright:

At Raceland our picture is a little bit different. We have shredders on both mills. We try to knife the cane all the way down as close as we can to the carrier so that we don't choke the shredder or give it too much of a load with the long cane. At the crusher we like to get somewhat long fibers so the crusher won't choke. All our shredded cane is voluminous so that we have to open our crusher considerable. We find that with shredding we have quite an increase in grinding capacity and less power at the mill engine. With the shredders we get an increase sucrose extraction. I don't see how they grind the hard canes without a shredder.

Mr. Bolin:

We have a four foot carrier and originally we had 22 knives on the carrier but we found that the cane was cut too fine had a tendency

as Mr. McNamara said, to choke the crusher. So with the idea of reducing fineness we removed 10 of the knives and we now have 12. We don't see any great difference in the fineness. It is still too fine. The first set of knives is about 12 to 14" from the carrier slats and the second is about 1" or about as close as we can get it without the danger of injuring the slats should we get something in the carrier. The cane is cut up something on the order of sawdust rather than being shredded. This may be due to the speed of the knives. I personally think our knives are running too fast, around 580. I have seen cane that has gone through knives at a lower speed that looked much better prepared for milling purposes. I am sure it wouldn't cause any trouble at the crusher. I think the main thing that you need is more of a shredding rather than a cutting job. I still think ours is too fine in spite of the fact that we have taken off half the knives.

Mr. Landry:

We like the cane to be fairly fine, particularly at the early part of the crop when our mills are in good shape, the turnplates are set up tight and not worn. But as you progress into the crop, when you begin to get wear on your mill and mill rolls begin to get slick, then we find we need a little lint in those cane pieces to get that cane through the mill. It's not a general practice but we have removed knives at the end of the crop when our mills are getting slick. We try to stay flexible there, we don't want to express a definite opinion. We like fine cane when we can handle it. When we can't handle it we get our coarse cane by removing a few of our knives.

POLYELECTROLYTE FOR SUGAR JUICE CLARIFICATION

By J. H. Thibaut

In the manufacture of sugar the degree of clarification affects all the subsequent stations of the factory. Monsanto Chemical Company's Plastics Division became interested in this problem some time ago and has developed a resinous polymer, Lytron X-886, a synthetic polyelectrolyte that has been evaluated as clarifying agent and found to work extremely well. Lytron X-886, when added to a normal juice in very small quantities from less than 1 ppm to about 10 ppm, increases the degree and rate of flocculation, as well as the rate of settling and produces scum or muds that are readily filtered.

To understand how the polyelectrolyte functions in the clarification of the raw juice it is probably well to go back and explain briefly the fundamental working of a polyelectrolyte on the flocculation of a colloidal suspension. Most solids suspended in water are negatively charged with respect to the water. As a result of this charge, the particles repel one another.

In the case of a raw sugar juice a large portion of the juice impurities are colloidal and do not combine or flocculate without some special treatment. The addition of milk or lime introduces an electrolyte, "Calcium", to the suspension. The positively charged calcium particles are attracted toward the negatively charged colloidal impurities. If the concentration of the calcium is sufficiently large, the repulsion between the colloidal particles is reduced so that the colloidal particles will pull together and flocculation results. Upon the addition of Lytron X-886 to a colloidal suspension containing a flocculating amount of calcium, the rate of flocculation and sedimentation of the impurities is greatly increased when compared with the juice containing the calcium alone. The overall result is more complete flocculation of all impurities even in the presence of extremely large quantities of mud having increased rates of sedimentation and filtration.

The increased rate of flocculation and sedimentation of a suspension upon addition of polyelectrolyte is explained on the basis of bonding by the polymer. The formation of bridges between the flocculating particles prevents these particles from flying apart again in their normal movement and the rate of flocculation is increased. The larger, more stable flock settles faster and filters better.

Evaluation of Lytron X-886:

The field evaluation work with Lytron X-886 started in October, 1952 in Louisiana. Several sugar houses were contacted and it was soon established that improved clarification and greater throughput in clarifiers was a pressing problem with all of them.

To obtain data the usual standard laboratory settling tests were conducted. Some of the many variables considered in the clarification of raw sugar juices were the order of addition of reagents, the alkalinity, temperature, concentration of Lytron X-886 and the nature of suspended impurities.

It was established first in the laboratory and later in plant testing that the juice should be limed before the addition of the polyelectrolyte. This order of addition brings into play the full effects of the polyelectrolyte. Several other basic materials and combinations were investigated in the course of the study and it has been concluded that the lime - Lytron X-886 combination is most effective.

The effects of PH were determined by varying lime concentration at fixed concentrations of Lytron X-886. The clarifying action of the polyelectrolyte was effective over the entire range of PH tested. Optimum results have been obtained at varying PH values at different sugar houses. Based on this improvement consumption of lime and subsider capacity may both be greatly reduced.

The amount of polyelectrolyte required to flocculate properly and settle impurities from raw juice varies from location to location. Field data indicate that from less than 1 ppm to about 10 ppm based on the total weight of a normal juice has been satisfactory. Caution should be observed not to overheat the juice because of a reversal in some of the reactions involved which produces a slightly hazy clarified juice.

As a result of field experience the importance of the solution concentration of the Lytron X-886 being added to the raw juice and importance of the point of entry into the system have been demonstrated. An aqueous solution of approximately 0.5% Lytron X-886 has been found to be most effective for getting adequate distribution of the small quantities of Lytron X-886 required in the juice. To obtain maximum results the polyelectrolyte should be added to a point in the system following liming where any vigorous mechanical stirring after the formation of the floc is eliminated. Vigorous stirring after the floc is formed tends to tear off particles and prevent settling. The effects of concentration and point of addition have been demonstrated in both cane sugar and beet sugar processing.

Proper treatment or raw juice with polyelectrolyte produces denser muds which occupy less volume and are more readily washed and filtered.

<u>Plant Evaluations of Lytron X-886:</u>

Based on the promising results of laboratory work conducted at Evan Hall Sugar Cooperation in Louisiana, arrangements were made to evaluate Lytron X-886 as an additive in the muds going to plant Oliver filters. The first runs were made by adding 4 ppm polyelectrolyte as 1% aqueous solution to the total muds removed from the clarifiers. This caused a change in mud characteristics and resulted in the formation of a better filter cake and cleaner filtrate. Continued plant tests at Evan Hall included the addition of 4 ppm polyelectrolyte to the raw limed juice

going to the Dorr clarifiers. With the start of Lytron X-886 additions the muds became heavier and improvements in filtering were reported. During the test period extremely poor juices, heavy with mud, were run and it was expected that production would fall off. The increased flocculation and subsidence rate attendant with the polyelectrolyte treatment made it possible to continue at about the same level of production.

In addition to the improvements in the clarification procedure it was also established that molasses viscosity was reduced when polyelectrolyte was used. This lower viscosity should be advantageous in the boiling house and in the separation of molasses from the crystal sugar.

Investigations and inquiries showed that the same problems in clarification were and are prevalent in Cuba and Puerto Rico. The use of mechanical cane handling equipment is constantly introducing new problems. At Central Cortado in Puerto Rico plant tests using Lytron X-886 were run over a period of six to eight weeks. This Central, which used a system of compound clarification, was experiencing unusual difficulties because of the introduction of mechanical harvesting. Production had dropped from 1700 tons to 1300 tons. Lytron X-886 was added as an aqueous solution at 10 ppm to the total juice after liming. Shortly after the addition was started muds in both primary and secondary clarifier became much heavier and within eight hours muds levels in the clarifiers had receded to a normal level and the rate of clear juices passing through the clarifiers had been increased. Production was returned to 1700 tons and was limited only by the fact that the plant had no method of getting rid of the muds other than putting them on the mills. Central Cortado is installing rotary filters to eliminate this bottle-neck.

The cessation of the use of polyelectrolyte addition in this plant again produced very thin muds and poor clarification and production dropped back to the 1300 tons.

VISCON FABRIC AS A FILTER MEDIA

By C. W. Stewart

Purpose:

To test the feasibility of using a fabric known as Rayon 85-D as a surface media for the filtration of sugar cane muds in plate and frame filter presses.

Equipment and Material Used in the Test:

To carry out the test two plate and frame filter presses 24" x 24" x 42 plates, side feed Shrivers were used. The mud pump is a 4 1/2" x 3" x 4" Fairbanks Morse duplex pump. The delivery line is equipped with a relief valve set to release at 50-55 pounds. The cloths used are 25" x 55", 21 oz. twill. The Viscon fabric used is Rayon 85-D. Muds from the Dorr and Seip clarifiers were used in this experiment.

Procedure and Results:

The filter presses were dressed with clean cloths as usual. On 21 plates (1/2 the press) beginning at the charge end, a sheet of Rayon 85-D was placed over the cloth. This was done so that the comparison would be made with the same material and under the same conditions, that is alkalinity, temperature and pressure. The mud was well mixed, pH raised to 7.5-8.0 and temperature to about 190-200°F. The pump was started and regulated at 25-30 strokes per minute (a normal speed). The mud was received by the Rayon covered cloths first as they were in the charge end of the press. Filtrate flowed from these plates 10 or 12 minutes before any filtrate came from the other section of the press.

After a two hour period the pressure had developed to a point where the relief valve was releasing the pump discharge back into the mud tanks and the filtrate was a mere trickle. The pump was stopped and the press allowed to drip for a few minutes then opened. Samples of the filtrate had been taken on both ends of the press and samples of the cake was also taken. The condition of the cake in the frames were examined. That in the Rayon covered end of the press was solid and well packed with only a small cavity near the inlet port in the frame. It remained whole in the frame when separated from the Rayon surface. The surface left clean and not smeared with mud. At the other end of the press the cake was not so solid, it had a large thin cavity in the center of the cake leading from the port to a distance well past the center of the frame. This cavity was filled with a soft pasty mud, an area about 1/3 that of the plate.

This operation was repeated 4 times, dumping the cake each time and closing the press again. After the 4th filling the mud supply

was exhausted and the cloths and Rayon were removed from the press. The unprotected cloths were badly smeared and the last cake on these were very soft.

The protected cloths were only stained and the Rayon was only slightly soiled. All cloths were washed, the Rayon rinsed in cold water and returned with the other cloths to the press. The press was then filled three more times.

The Rayon covered cloths continued to yield good cake and good flow rate. The unprotected cloths were choked up on the 3rd filling. The cloths and Rayon were removed from the press and the cloths laundered in the usual way. The Rayon sections were placed in the was ing machine with warm water and a small amount of soda ash. They we then tumbled for 20 minutes, rinsed in clean water and placed on the dr ing racks to drain.

The second filter press was then dressed with half-Rayon covered cloths and half unprotected cloths as was done in the first case. The rayon covers (filtering media) were used in the presses for seven days, terminating the grinding season. They were washed after each 6 or 7 cycles and returned to service.

It should be pointed out that our operation is not continuous. Muds and juices are held over for periods of time to accommodate class Some deterioration occurs and for that reason the muds do not always filter so well. Also on some occasions we have no muds to filter.

Observations:

1. Increased filtration rate
2. Formed better cake
3. Protected filter cloths
4. Can be used with broken cloths
5. No improvement in clarity of filtrate (By Luximeter test)
6. Material is washable
7. Separates easily from cake but can be torn if given rough usage.
8. Does not shrink

The cost of Viscon non-woven fabric (Rayon 85-D) is 13¢ per sq. yard, in rolls 36" wide and 1000 yards long; or a section 25" x 55" is 14¢; whereas, a filter cloth the same size of 21 oz. twill is $3.85.

It is made in rolls 36" or 50" wide and produced by The Visking Corp., 1301 E. Eight St., North Little Rock, Ark.

We have planned to conduct further tests on this material during the next milling season.

MECHANICAL CANE PLANTING, MY EXPERIENCE IN LOUISIANA

By M. V. Yarbrough, Youngsville, Louisiana

In the early 1940's the writer decided to explore the possibilities of mechanical cane planting. This presentation will be a resume of the results of our investigations and experiments at Youngsville up to this time. In evaluating the conclusions set forth it must be borne clearly in mind that our attempts were confined to the development of a machine which would advantageously plant CO-290 cane in our light sandy lands and in fields in which there is considerable slope. Although we systematically and continuously conduct field scale tests of all other promising varieties of cane, CO-290 is still, by a substantial margin, the most profitable variety for us to produce. Our conclusions herein expressed would not necessarily therefore be applicable to the planting of other varieties of cane in different types of soil.

At the outset we realized that it would be much easier to design a planter to handle short seed pieces, from two to four joints long. Accordingly our first step was to make experimental plantings of both full length and short seed pieces. Tropical experience in planting sugarcane indicated the possibility that stripping of the leaves from the seed might have an important bearing on germination. Accordingly several experimental plantings were made using stripped and unstripped seed, planting full length stalks and three eye seed pieces and planting all such seed both untreated and also treated with all of the various fungicides used or recommended in this country, and in Australia and Africa. In these experimental plantings we included CO-290, CP26-116 and CP29-320. The results shown by these plantings were consistent year after year and indicated clearly a few facts that were very helpful in determining the characteristics of the planting machine which we should attempt to build. These few simple facts were as follows:

1. The cutting of seed into short pieces increased primary germination in the fall but resulted in seriously reduced stands of cane the following spring and in succeeding stubble years as compared to the planting of the full length stalks. This was more pronounced with respect to CO-290 than to the other two varieties.

2. Stripping of cane accelerated complete germination in the fall as much as three to four weeks as compared to unstripped cane. The stripping seemed also to promote germination in the full length stalk so that the lower eyes germinated more nearly simultaneously with upper eyes. This was true with respect to CO-290 and CP29-116 was not true of CP29-320.

3. None of the fungicides available at the time proved to be of any practical benefit when used either with full length stalks or short

short seed pieces. We understand that fungicides effective for this purpose are still not available to properly meet our Louisiana conditions of winter dormancy.

After noting the above results with full length stalks and three eye seed pieces, we experimented with seed pieces half the length of the stalk. Such seed pieces contained from five to seven eyes. Plantings were made with full length stalks, the top halves of stalks and the lower halves of stalks. Results of these plantings continued to be overwhelmingly in favor of the use of full length stalks, and completely stripped, in order to secure prompt germination the highest fall germination and the best retained spring stands.

While doubtful that we would find sufficient labor to strip our seed clean or that it would pay us to do so, it was at least clear that a planting machine to suit our conditions must plant full length cane.

Before undertaking to design and build a machine we secured all of the information available regarding the various planters in use in other parts of the world and purchased a tractor drawn planter Model TP8CC, from Wyper Brothers, Ltd. at Bundaberg, Queensland, Australia. We knew that this machine was designed to plant cut seed pieces and would therefore give us but little information of a general nature. However, good germination of CO-290 is dependent upon the differential in level between the water furrow or middles and the level at which the seed piece is planted. This item is of particular importance in the lower levels of sloping fields. This proper differential in level has always been very difficult for us to maintain in opening our planting furrows for conventional hand planting. With a mechanical planter doing its own opening and partial covering, the importance of precision in this operation assumed great proportions because the relationship between the level of the water furrow and the level at which the seed would be planted by a machine could not be continuously observed. The depth of planting by the Wyper Bros. planter which we selected was claimed to be subject to very precise control. We therefore purchased this planter in order to make use of any of the ideas which they had developed to accomplish this important objective. I may say now that the opportunity to observe the opening tool used by Wyper Brothers on their machine has been worth many times its cost to us. Not only did we adopt their principle for our planting machine but we are still using tools which operate on that principle to open our planting furrows at the present time. More will be said about this subject later on.

In 1947 and 1948 I was assigned the task of making a study of present and future prospects of mechanical cane planting to be reported at the 1948 meeting of our Technologists' Society. In connection with that study questionnaires were submitted to representative planters throughout Louisiana to ascertain their opinions as to the various requirements for the most successful planting of sugar cane in Louisiana. The concensus of those opinions expressed was included in my presentation in 1948 and appears again below:

CONSENSUS OF TWENTY-FIVE OPINIONS

POSSIBLE ADVANTAGE	AVG. RANK	RANKED FIRST
Precise spacing lengthwise to reduce gaps in stands	1.92	15
Precise depth of coverage with soil	2.00	0
Precise spacing lengthwise to effect seed economy	3.96	0
Close furrows immediately after opening	4.00	0
Controlled compacting of soil around seed	4.24	3
Control of planting furrow depth	4.28	4
Narrower spacing of seed in furrow	4.84	1
Pulverization of soil contacting seed	5.40	1
Reduction of plant costs	5.44	2
Reduction in time required to plant crop	5.60	2
Reduction in labor required	6.28	2
Uniform row spacing for multiple row cultivation	7.00	0
Handle seed cane less roughly	7.36	1
Ability to plant crooked cane	11.00	0

Note: Had all individual opinions ranked any single advantage greatest in importance its "Average Rank" would have been 1.00. Also in the tabulation, under column headed "Ranked First", it is shown the total number of opinions in which each advantage was ranked first in importance.

In the spring of 1948 we felt that we had progressed far enough in our study of the subject to undertake to design and build a planter to meet our own requirements at Youngsville. We felt it possible also to make the planter capable of fulfilling the requirements for ideal planting as reflected in the above consensus of opinion. Accordingly during the summer of 1948 we built a cane planter which we first used in the fall of 1948 in order to ascertain exactly the nature and extent of the benefits, if any, incidental to mechanical planting.

Before describing the construction and operation of our planter, I will summarize our conclusions relative to the possible advantages and disadvantages incidental to mechanical planting using machines like our own. These conclusions are as follows:

1. With the planter 1.75 tons of seed per acre is adequate. Planting by hand we use from 3 1/2 to 4 tons of seed per acre. These figures are for planting CO-290 in which the joints are relatively short and stalks relatively large in diameter as compared to most of the other commercially released varieties.

2. Land must be prepared ahead of the planter which is then capable of opening an ideal planting furrow at any desired level with respect to middles or water furrows.

3. Covering and compacting tools on the planter cannot cover as deeply as we must cover our cane in our acres. However, as much as three inches of coverage can be accomplished by the tools on the planter proper.

4. An economical planting operation would necessitate the

use of not less than five planting machines. If five or more machines were used labor costs for the actual handling and planting of seed could be reduced as compared to hand planting.

5. Economical use of planting machines necessitates a com plete change in the method of handling seed cane. A portable crane, su as a dragline, must be stationed as close as possible to the field being planted. Seed should be hauled in tractor carts in slings to the crane a then unloaded and stacked on the ground still in the slings. The seed is then lifted from the ground by the crane and placed on the planter still i slings. To gain full potential capacity from the planting machines the crane must be in close proximity to the field being planted.

6. The seed should be loaded corded into the tractor carts in small bundles not exceeding 1 1/2 tons each, with butts all one way and the tractor cart equipped with a false end to permit handling of bun- dles of cane only one stalk length long.

7. Slings should be of woven rope construction to minimize tangling of the stalks in handling.

8. The machine cannot completely plant between the head- land and quarter drain on either end of the row since there is a lag of several feet of row at all times in the process of being planted. Com- pletion of the planting of row ends has to be by hand, using seed thrown off the planter on the headland.

9. When planting out row ends by hand the seed can be kick to each side of the quarter drain. Cross drains inside of fields present an entirely different problem. Parallel coulters in front of mule drawn drain plows will not satisfactorily cut out the seed which has been plante through the cross drain and covered by the planting machine. Conven- tional power driven drain machines do a rough, spotty job of cutting out the cane planted through cross drains. Possibly a modification of the blades on the power driven drain plows might provide a satisfactory me of cutting out such seed planted through the drains. This has not been tried.

10. There is no difference in either yield of cane per acre o sucrose and purity in mechanically planted cane and hand planted cane which is properly planted. I had hoped that uniformly distributed stands of mother stalks, or stools, which it is possible to achieve with the me- chanical planter might result in more uniform suckering and growth and maturity of suckers incidental thereto which might result in either highe tonnage of cane per acre or better maturity or both, as compared to har planted cane in which often times there is room for more suckers in sor stools than in others on account of difference in proximity of stools. Thi was not the case with CO-290. In plant cane and first, second and third year stubble from all mechanical plantings, the yield per acre and the analysis of the juice from the machine planted and hand planted areas were for all practical purposes identical. The suckers in CO-290 all tend to come out at the same time, more so than some of the other vari- eties, particularly CP36-105. With such a variety more uniform spacin

of stools might result in increased yields of sugar per acre where it did not with CO-290.

In harvesting cane for the mill we put six rows on each heap row. Because of this fact in all of our mechanical planting experiments, we planted every other six rows of cane in each of the fields by machine and planted the intervening sets of six rows by hand. In order to retain positive identification of the six row sets, in planting out the ends of the machine planted rows by hand we stopped these sets of rows half way between the headland and quarter drain. In this way as the experiments progressed into the stubble years there was always positive identification as to machine and hand planted cane in the various fields. At harvest time the two central rows of each set of six rows were cut to form the heap row, with the outer rows of the set then being piled onto the heap row. This resulted in every other heap row being machine planted and every other heap row hand planted in all of the fields in which we conducted machine planting experiments. In hauling the cane to the mill after burning we had two cane loaders each with its corresponding sets of tractors and wagons and each hauling every other heap row. Each bundle of cane which we weigh at our factory is sampled for sucrose and purity. Accordingly, because of the large number of samples and tests involved we believe that our average results both of weights and tests of the cane were extremely accurate.

At the outset it was my opinion that mechanical planting could be justified in our own operations only by virtue of at least 10% increase in sugar per acre as a result of mechanical planting. In our operations we plant only about 600 to 700 acres of cane each fall. This is not enough to justify the use of as many as five planting machines. Unless five or more machines can be used, there can be little or no saving in labor cost as compared to hand planting. Accordingly, since no increase in yield of sugar per acre was achieved we built no more planting machines and we no longer use the one we have. Our study of the problem did however, pay off handsomely. After briefly describing the construction and operation of our machine, I will go somewhat into detail regarding the benefits derived by us as a result of changes in our hand planting operation as a result of our study of the subject.

Our planter is capable of opening a perfect planting furrow in well prepared soil, planting the full length cane at any desired rate in any desired pattern, covering the seed pieces with any amount of dirt desired up to a maximum of about three inches of compacted depth and then compacting the dirt cover to any reasonably desired degree with a weight loaded compacting wheel.

The machine itself is a 2-wheel tractor drawn trailer attached with a ball and socket type hitch to a trunnion type drawbar on the tractor the trunnion consisting of the drawbar proper which is free to swivel up and down and through the connection with the lift frame of the tractor constituting a trunnion. The depth of planting furrow is controlled by a down position stop on the drawbar. With the tractor lift connected to

drawbar, the front end of the planter including the opening tool is lifted out of the ground at the headland.

Four men are required to operate the planting machine in addition to the driver of the tractor which pulls the machine. Two of these men place the seed cane in planting slots one stalk at a time. One man at the rear of the machine controls the rate of planting, according to length of stalk, and raises and lowers the covering tools and compacting wheel at ends of rows. The additional man is required on the seed hoppers to thin down the layer of seed as it discharges from the hopper bottom onto the flat tables. With extremely crooked tangled cane two men instead of one are required on the seed hoppers. The hopper bottoms and planting chains are ground driven from one of the planter wheels and are stopped and started by a jaw type clutch controlled by the man at the rear of the machine.

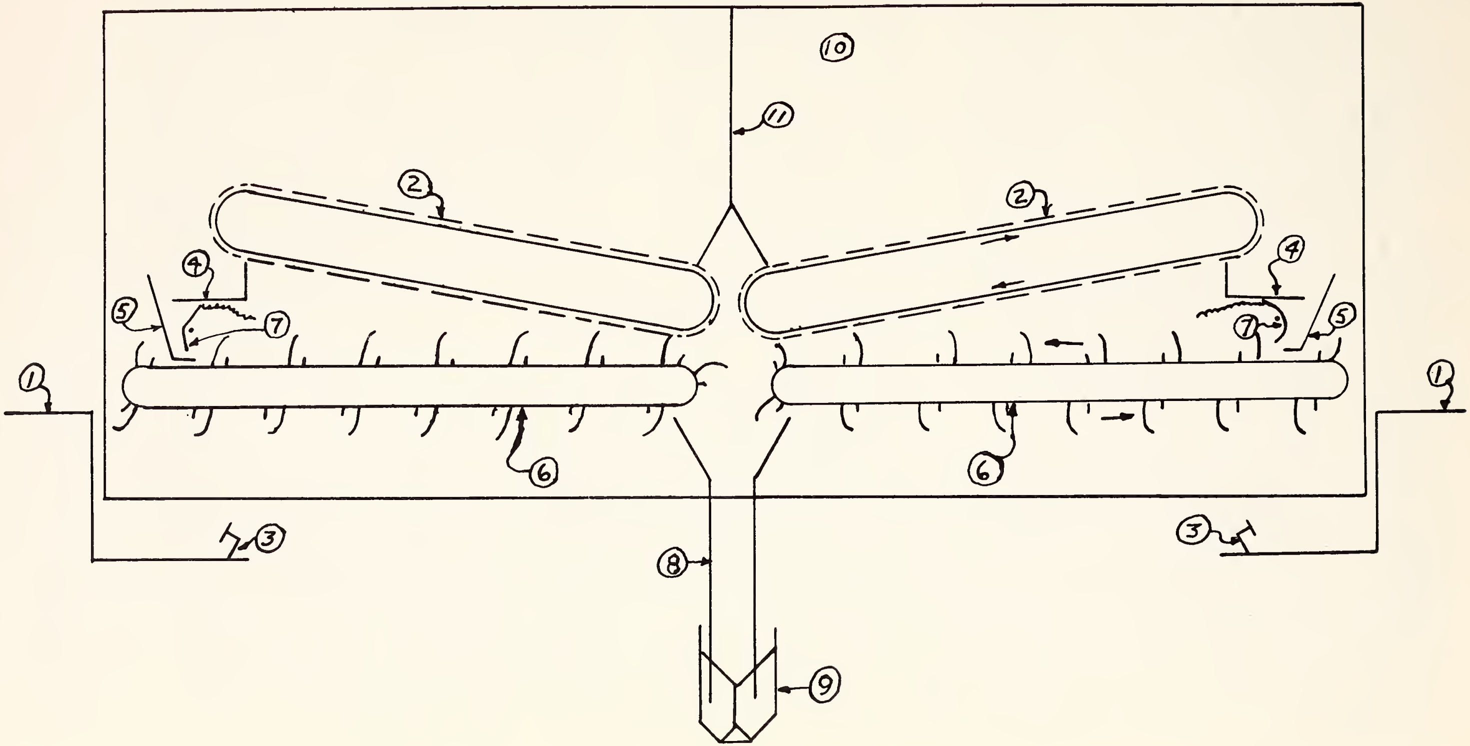
If you refer to Sketch No. 1 which is a schematic front phantom elevation of the planting machine you will note the seats for the two men who place the cane in the planting slots are Numbered 1. As the operator requires more cane on flat table No. 4 in front of him, he depresses pedal No. 3 which operates a hydraulically controlled clutch which slowly inches hopper bottom No. 2 in the direction shown by the arrow discharging cane onto flat table No. 4. Operator grasps the cane one stalk at a time as it rests on flat table No. 4 and pulls it toward him into planting slot No. 5. The operator is in a comfortable position, does not have to pull the cane toward him more than 6 or 8 inches to drop it into the planting slot and is readily able to handle the stalk of cane with only one hand and with either hand, actually doing his work in a hand over hand fashion. The planting slot No. 5 is normally closed toward the center by a spring loaded pivoted gate No. 7 which holds the single stalk of cane in the planting slot until attachments on planting chains No. 6 engage the stalk of cane and pull it from the planting slot, opening the spring loaded gate No. 7 which springs shut with a loud click as soon as the stalk of cane is removed from the planting slot. The operator No. 1 drops another stalk of cane into the planting slot, as soon as he hears the click of the gate No. 7. It is readily possible with cane of average length (and CO-290 is relatively short as compared to most varieties) for operator No. 1 to keep the planting slots full with the planter drawn by an Allis Chalmers cane field type tractor in conventional low gear with the engine governor modified to control the tractor engine speed at about 2/3 to 3/4 of normal. The two planting chains No. 6 are driven by spur gears which mesh. These spur gears can be so timed that a stalk of cane is dropped simultaneously from each of the planting chains No. 6 or so that at evenly spaced intervals a stalk of cane is dropped alternately from one side of the machine and then from the other. With the spur gears timed as first mentioned the machine plants two canes parallel and the joints in the cane lines can be lapped any desired amount by the relative speed at which planting chains No. 6 are operated with respect to the combined functions of stalk length

Youngsville Planter

Youngsville Planter

Sketch No 1.

(Front Elevation)



and of forward travel of the cane planter. This sounds a little complica ted but actually the operator at the rear of the machine can at all times see a few inches of the pattern which he is planting. If there are gaps between the ends of the stalks of cane in the same line in the furrow he can shorten those gaps or completely close them or close them and leav any desired amount of lap by merely increasing the speed of the planting chains No. 6 which are connected to the ground driving wheel through a Reeves Variable Speed Transmission. If, on the other hand, the gears which drive planting chains No. 6 are timed as in the second instance, then two lines of cane are planted, with the joints in each line exactly and evenly broken by the joints in the other line. Again, as in the forme case, by changing speed of planting chains No. 6, a gap of controlled length can be left between the ends of stalks in adjacent lines in the furrow or the gaps can be completely closed and lapped any amount desired In fact, in the latter timing position any rate of planting desired can be achieved from one extreme of one stalk in a single line with gaps equal to the length of the stalk between stalks or to the other extreme of four parallel lines of cane in the furrow with all joints equally broken and lapped by adjacent lines.

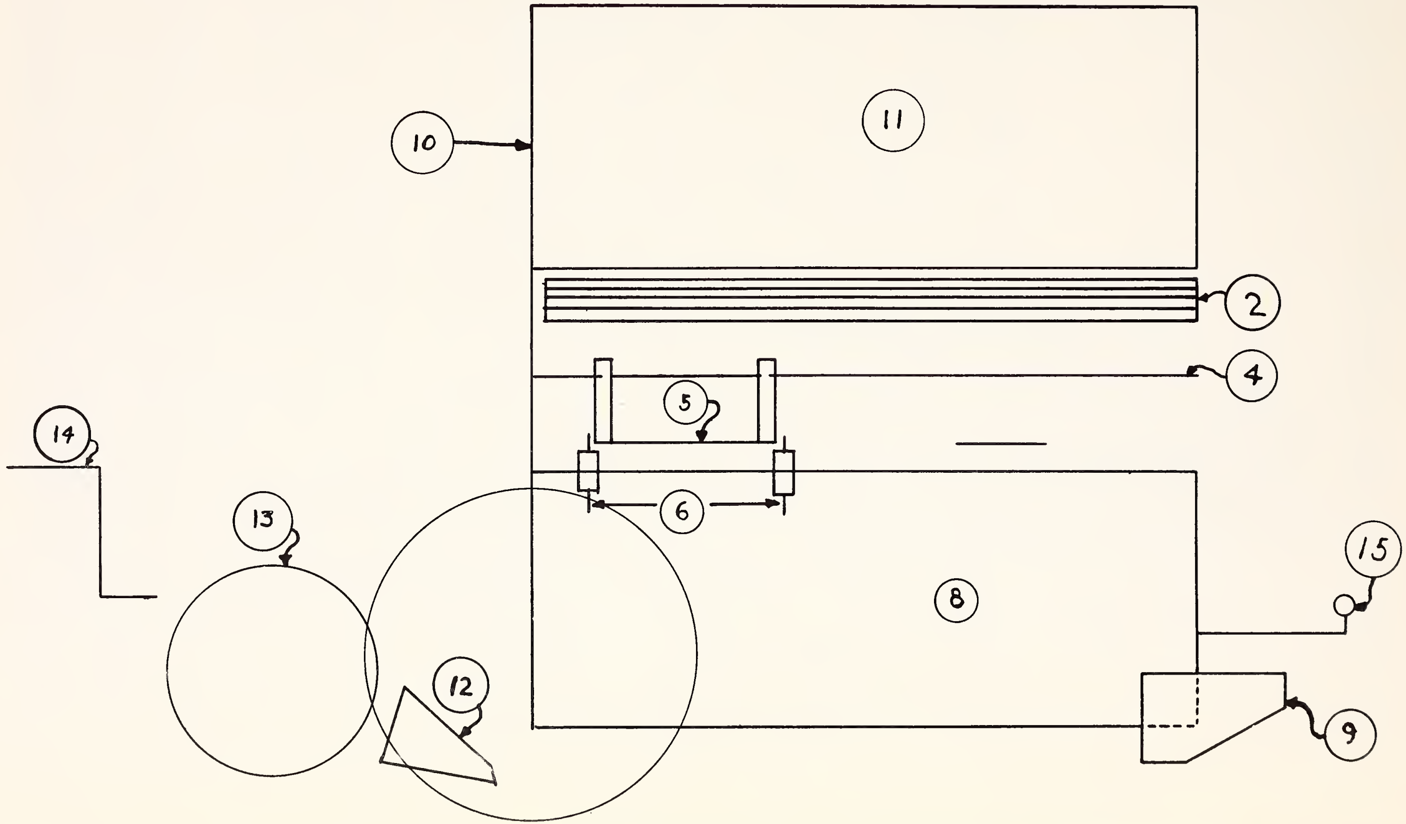
The pattern of planting which we found most successful, resulting in the most uniformly spaced stools, consisted of two lines in the planting furrow with the joints in each line equally broken by the joints in the other line and with a gap between the ends of stalks in each line, with butts in same direction and the gap ranging from zero up to about 8 inches. Planting such a pattern with CO-290 requires from 1.5 to 1.65 tons of seed per acre. It is most important that the seed be proj erly topped if both seed economy and regularity of stands are to be achieved. Every foot of stalk which appears to be seed must really be seed and not immature top growth.

On Sketch No. 1 the cane seed is discharged from planting chains No. 6 into planting chute No. 8 through which it falls into the planting furrow which has been opened by opening tool No. 9.

The seed hopper is divided by a dividing wall Numbered 11. A bundle of seed cane is placed on each side of this dividing wall. If desired to plant two lines of cane with butts of stalks facing opposite in the two lines, the seed is loaded onto one hopper with the butts to the rear and onto the other hopper with the tops to the rear. A solid sheet steel hopper back, numbered 10, extends completely across the machine at the rear of the hopper bottoms. The bundle of seed is loaded into the hoppers so that the butts nearly touch this hopper back. As the seed is dragged by the operator into the planting slot No. 5 from table No. 4 where the ends of the seed are still very close to the hopper back No. 10 the operator No. 1 slides the seed back so that the butt touches the hoppe back No. 10 at the time it is dropped into the planting slot No. 5. If this were not done the planting pattern would be uncontrollable.

Sketch No. 2 is a schematic side phantom elevation. Shown

Youngsville Planter Sketch #2
(Side Elevation)



are the following component parts of the machine:

2. Seed Hopper Bottom
4. Table
5. Planting Slot
6. Planting Chains
8. Planting Chute
9. Opening Tool
10. Seed Hopper Back
11. Seed Hopper Dividing Wall
12. Covering Tools
13. Compacting Wheel
14. Rear Operator's Seat
15. Ball Hitch to Tractor

So much for the description of our planting machine. Now we will turn to a phase of this subject which it is hoped may prove to be of some immediate practical benefit to some of our friends as it has to us in enabling us to secure a much better job of planting by hand and with less labor per acre than we formerly required.

In the first place we have shown on Sketch No. 3 an opening tool which we developed as a result of our experience with the mechanical planter. In the type of soil which we farm this opening tool has filled a long felt need. It operates as a mole, opening a furrow of predetermined cross section without turning any dirt whatsoever. In this opening process many large particles of dirt or clods are ground up and broken into finer particles. The clods which are not broken up are pushed into the side of the opened furrow. The dirt which is pushed to the top of the ground and rests on each side of the open furrow is the most finely pulverized dirt within the area of the open furrow. The pressure of the tool actually floats the finer dirt to the top of the ground. It is this finer dirt which then, in the covering process, is pulled immediately onto and around the seed pieces. It is the difference between having more finely pulverized or less finely pulverized dirt immediately in contact with the seed pieces. The extent to which the former excludes air from the seed pieces and inhibits dry rot as compared to the latter has, in our case, been amazing.

Furthermore, since this tool does not turn or throw any dirt it neither tends to dig into or come out of the ground. The depth of planting furrows opened with it can be very precisely controlled with respect to the level of the water furrow. This has enabled us to completely control red rot which several years ago threatened to force us out of the production of CO-290.

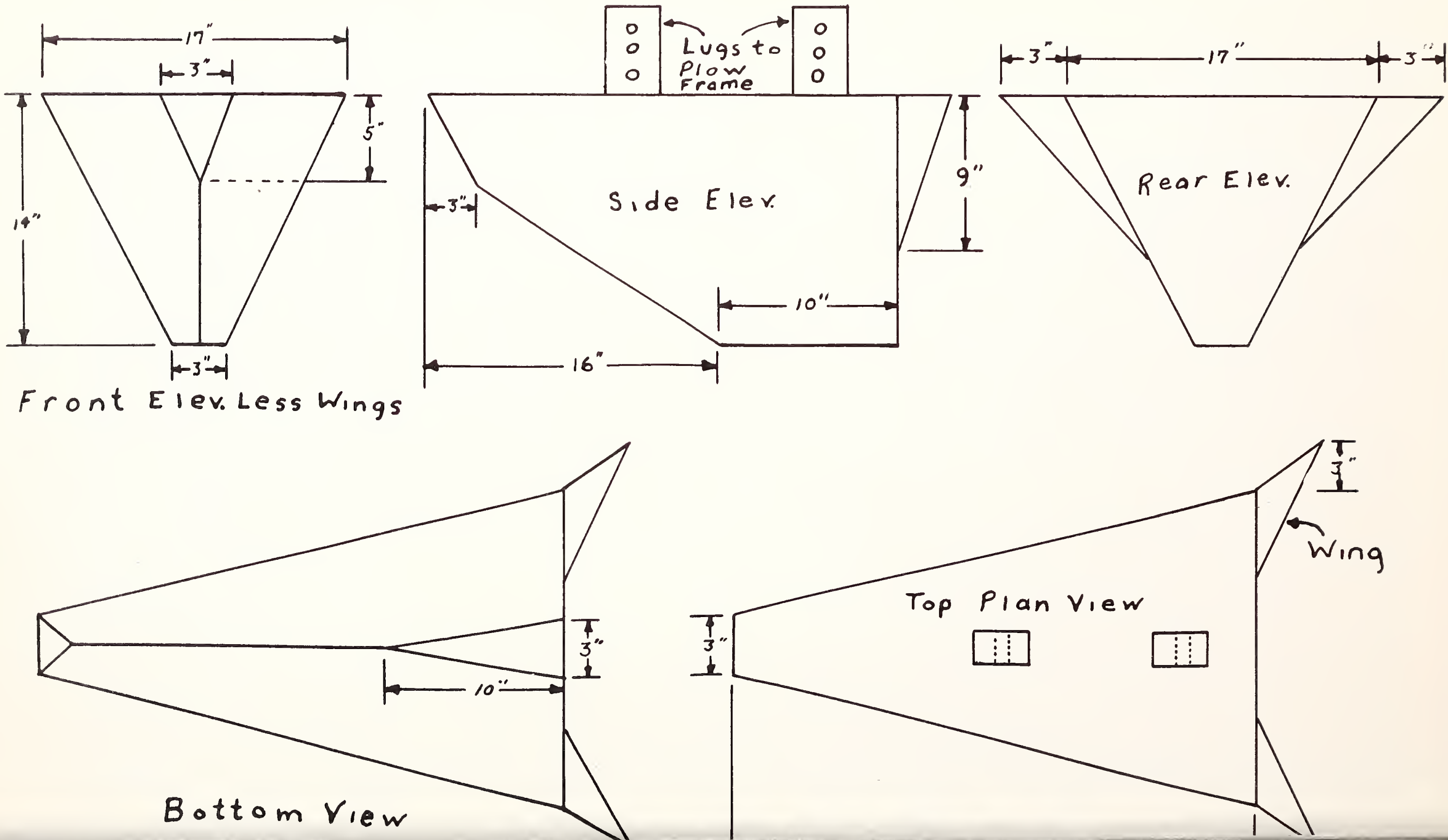
The shape of the opened furrow left by this opening tool is such that even crooked seed cane goes to the bottom and plantings at even very heavy rates are confined to a sufficiently narrow width so that narrow offbar operations can be conducted with little or no mother cane damage.

Careful and repeated examination of gaps in plant cane spring after spring revealed the fact that in practically all instances the gap was

due to a complete lack of seed, sometimes the upper part of a stalk or two might be there, but void of mature eyes, and in other instances there simply was no seed in the gaps. In those days we had been planting our cane using six cane droppers on two tractor carts behind a tractor, with the tractor slowly inching down the row and every once in a while being called to a halt by the last dropper on one side or the other getting so far behind that he finally yelled "Uncle" or some other such word. We have completely eliminated all of the gaps due to lack of seed which together with elimination of red rot means that in recent years we have eliminated the gaps in our stands. We are also planting substantially more cane per dropper man hours than ever before. We still use six droppers dropping cane from two tractor carts behind the tractor, planting the row on each side of the row which the tractor carts straddle. We slow down the engine of the tractor so that it will govern at about 850 or 900 RPM. The tractor driver places his machine in low gear and lets the tractor roll continuously with throttle open. The droppers are instructed to do the best possible job of dropping and not to stop the tractor unless very seriously tangled seed may necessitate it. We then follow up this primary planting with a secondary planting crew. This is a crew of three selected men riding in one tractor cart behind a tractor, one man at each side of the cart and one man at the rear of the cart, with seed in the cart so that these three men can fill in the gaps in three rows of cane each pass. Actually these three men do the secondary planting for two 6 man initial dropping crews so that we have increased our total labor requirement by only three droppers for each 12 droppers previously used and one tractor driver for each two tractor drivers previously used. We are actually planting from 25 to 30% more cane per dropper per day under this system than we did formerly, it is easier on all of the men to work the long hours during the rush of planting and our stands are consistently all that we would want them to be. Where formerly over our entire acreage we seldom reached 20 tons per acre average and never thought of carrying second stubble, we are now consistently averaging from 22 to 25 tons per acre. Last year on 1767 acres of cane, approximately 15% third year stubble and 30% each first year and second year stubble and 25% plant cane our overall average yield per acre mounted to 25.13 net tons. We had less rainfall between June 1 and November 10th than ever before in 33 years of record keeping. Our increase in yields has been due primarily to elimination of gaps planted into our fields at planting time. It is entirely possible that formerly we were not doing nearly as good a job as some folks when we were doing our planting in a once-over operation, but one thing is certain, we were doing a poor job and the system we are following now is resulting in both a reduction in labor cost and as good a job as can be done from the standpoint of elimination of gaps.

We are fortunately located in that we are at the edge of the sugar belt and are able to employ relatively large quantities of field labor during our planting season. CO-290 is much softer than some of the other varieties and accordingly may suffer more damage from

Youngsville Opening Tool Sketch #3
(Lugs for attaching to plow frame shown only on side view)



carrier and piler chains when harvested for seed by machine. Since CO-290 is also very susceptible to red rot it is likely that the stand damages which result from damage to the center of the seed piece such as mashing by the harvester chains is greater than would be the case with the more resistant varieties. Be that as it may, I have become thoroughly convinced by the importance and value of planting properly prepared seed that for many years we have refrained from cutting our seed with harvesters rather doing it all by hand. Not only do we minimize damage to the seed itself but we also secure a much better topping job than is possible in CO-290 with a harvester. To load our seed cane we remove the piler from one of our loaders and pick up the seed from the heap row grabful by grabful. It is readily possible to load with one loader, all of the seed we can plant without subjecting the seed to the rough treatment which is incidental to the piling by the loader. I am thoroughly convinced that all of the care which we can and do exercise in the preparation and handling of CO-290 seed cane is thoroughly justified by the results obtained. I do not from experience know the extent to which this would be true with respect to the other varieties of cane which are generally produced in Louisiana today.

THE FAS FLO FILTER-ITS USE IN SUGAR REFINING AND IN FILTERING THE CLOUDY OLIVER FILTRATE AT SUPREME SUGAR REFINERY

By J. N. Foret, Jr.

PART I

The Fas Flo filter is a new horizontal leaf type that was used successfully in plant operations at the Supreme Sugar Refinery, Supreme, Louisiana. It consists of a vertical cylindrical shell in which there are horizontal leaves that filter only on the top surface. There is never any danger of the cake falling off, because the leaves are in a horizontal position.

Each leaf has its independent outlet pipe, which goes through the bottom of the filter into a manifold. Before it runs into the manifold it flows through a transparent tubing and a shutoff cock which make it evident whether or not all the leaves are running clear. If any leaves are running cloudy, they can easily be shut off.

Any individual leaf can readily be removed from the filter without disturbing any other leaves by raising the shell and loosening the union which connects the leaf to its outlet pipe.

Each leaf section has a groove around the entire element, so that the 12 oz cotton cloth can be caulked into this with a piece of cotton rope and held firmly against the leaf. There is no sewing at all when placing a new cloth. The cloth lasts from 4 to 6 months. The cloth costs 87¢/yd., and it requires 80 yds. to dress one - 540 sq. ft. filter with 48 elements. It takes about five minutes to replace the cloth on the element. It is evident from the above that the cost of cloths is almost a negligible item in the cost of operation.

There is a small motor and reducer under the body of the filter, which revolve the vertical sluice pipe and which form part of the mechanism for discharging the cake from the leaves. The vertical sluice pipe has a smaller horizontal pipe for each leaf, which is located 1 5/16" above the leaf filtering surface. Each of these pipes has 4 spray nozzles of special design, which give a very thin fan-shaped spray extending across the entire leaf. Since these sprays operate at 60 lbs. water pressure and are about 1" above the cake, this solid sheet of water removes the cake from the cloth in about 10 minutes as it revolves.

PART II - The Fas Flo Filter in Refining:

Since August 3, 1954 we have been using the 540 sq. ft. filters in plant operation. One of the filters is now being used as a trap filter. It is precoated on Monday morning with 50 lbs. of diatomaceous earth and runs without additional filter aid until Saturday morning. It takes care of 650 tons of sugar per day. At the end of its cycle on Saturday morning it is sluiced for ten minutes to clean the cloth to make it ready for another week of operation.

Four of our 540 sq. ft. filters are used in filtering first filtration liquor. We use P_2O_5 acid and lime but we have no clarifiers; therefore, these filters filter out all the impurities from the melt liquor, including gums, albumins and pectins, also, the once used activated carbon and filter aid, with additional filter aid added.

During refinery operations the filter is precoated with 50 lbs. of filter aid and operates for 3 to 4 hours. During this complete cycle, the Fas Flo will filter 58 Brix melt liquor at the rate of 7 to 8 gallons per sq. ft./hr., depending on the quality of raw sugar, with .50 lbs. of filter aid and .40 lbs. of activated carbon per 100 lbs. of raw sugar melted. At the end of its cycle the filter is stopped and sluiced. After the filter is drained of its melt liquor content, compressed air is used to blow the liquor out of the cake. The sweetening down to -5.0 Brix takes 700 to 800 gallons of water and from 7 to 8 minutes. The filter is then sluiced for 7 to 10 minutes at 150 GPM, which makes it ready for another cycle. It takes about 40-45 minutes before the filter is back in operation.

We have checked the sucrose content in the cake and found it to run from 0.3 to 0.0%. This low sucrose content is accounted for by the uniformity of the cake being held on top of the leaves where the majority of liquor is blown out with compressed air. Therefore, the hot water has only to remove the sucrose from a uniform cake.

Since placing these four Fas Flo filters, we have removed two 500 sq. ft. plate and frame presses and five 248 sq. ft. Bowsers. We have increased out production 900 bags of refined sugar daily with a decrease of 1,000 lbs. of filter aid and 300 lbs. of carbon per day.

PART III - The Fas Flo Filtering Cloudy Oliver Filtrate:

Everyone knows that the present harvesting methods have created a large problem in clarification. Continuous rotary vacuum mud filters had really been doing a fair job until mechanical harvesters and mechanical loaders were used. The present rotary vacuum mud filter is really not a filter but only a strainer, and little has been done to discontinue the practice of recirculating the "fines" that go through the screens.

This past grinding season 1954, at Supreme, we decided to try to filter the cloudy Oliver filtrate with a 540 sq. ft. Fas Flo Filter. The cloudy Oliver filtrate was diluted 10% with hot water and limed to 7.5 - 8.0 pH. It was heated to 170°F., and 100 lbs. of filter aid were added to 1,000 gallons of the diluted cloudy filtrate. It was then pumped to the filter by means of a centrifugal pump. The filter was in operation for 1:00 hour and had a cake of 1/2" thickness at the end of the cycle. The cake was not sweetened with hot water but instead was blown out with air. The cake was analyzed and had a sucrose content of 6.0. Counting the time the filter was taken out of filtration, placing it back in operation required forty-five minutes.

We filtered 80% of the cloudy Oliver filtrate during the entire grinding season except for 1 week of mud filtration at a grinding rate

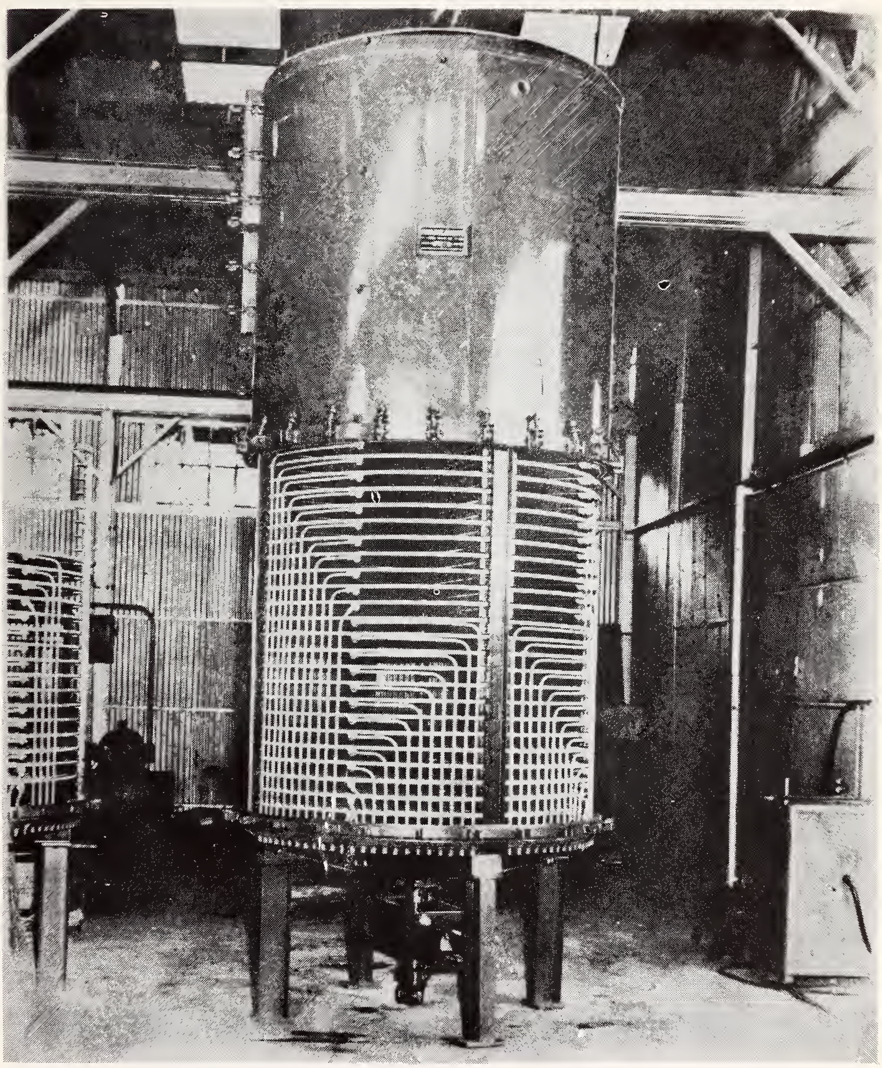
of 130 tons per hour. After we had been in operation for a few hours, there was a very marked improvement in the clarity of the so-called "clear" Oliver juice from the continuous mud filter. However, it was not considered clear enough to send to the evaporator; so it was returned to the liming tanks.

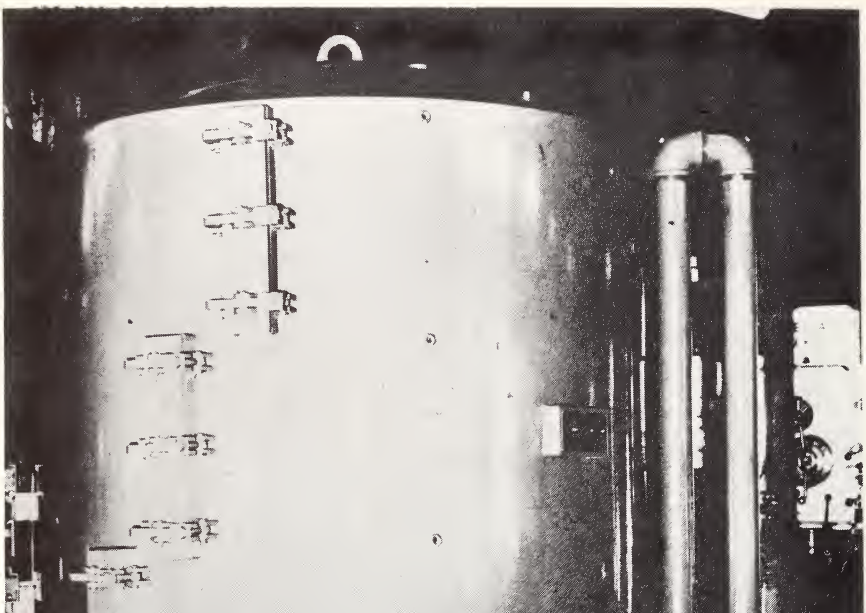
This report is not presented with the idea of proving actual or theoretical losses due to inversion caused by the recirculation of muddy juice, but we all know that there is a tremendous loss due to this recirculation. However, I would like to point out the following:

1. By running the Fas Flo during the grinding season continuously on the cloudy Oliver filtrate, we increased our grinding rate from 118 tons per hour to 130 tons per hour. During rainy weather, we did not have to slow down the mill as before, because the clarifier still ran clear.

2. Our yield increased 3.83 lbs. of 96 test sugar per standard ton of cane. As you can see, this certainly did offset the 1/2 lb. of filter aid we used per ton of cane and the additional labor cost.

We hope that the information given in this report will be of some help for some of your clarification problems. Also, even though we experimented filtering the muds from the clarifier for a week and did a good job, we feel that we do not have enough information on this subject. However, we plan on running muds in 1955 and would be pleased to have the opportunity of giving you the results.





EVALUATION OF SUGAR CANE VARIETIES
Season 1954

By Wilhelmus Melis and C. W. Stewart -- Audubon Sugar Factory, Louisiana State University, Baton Rouge, Louisiana.

INTRODUCTION

In 1954 the Louisiana State University entered into a contract with the United States Department of Agriculture whereby the Audubon Sugar Factory was directed to conduct a series of cane milling tests to determine the effect of progressively longer periods of delay between harvesting and milling sugar cane upon its milling characteristics and the yield and quality of juice obtained for production of sugar.

The schedules used in this investigation were outlined by representatives of the Regional Research Laboratory of New Orleans, the American Sugar Cane League and the Audubon Sugar Factory of Louisiana State University. The American Sugar Cane League with Mr. Durbin and Mr. Lauden, and Capt. Chambers of the penal farm at St. Gabriel supplied all the cane samples for the tests.

In the investigation five varieties of cane were used. They were CP44-101, which was used as a standard for comparison, CP44-154, CP47-193, CP48-103 and NCO-310.

This paper will be restricted to reporting only the milling characteristics as near as possible on the same basis that these reports have been prepared for the past 4 years. However, two changes were necessary: (1) only the first and second test of each group will be considered, (2) the stubble samples and plant samples are considered separately.

In Table I it will be noted that only 2 stubble and 2 plant samples of each variety have been considered. The other samples were delayed in processing 9 to 15 days and because of the deterioration noted it would be misleading to use the results as representing the actual quality of the varieties.

Due to climatic conditions existing in the Fall of 1954 it was found that the plant canes had attained a more advanced state of maturity when processed after Nov. 15 than the stubble canes had that were processed between Oct. 20 and Nov. 15. For this reason, the stubble and plant samples are considered separately when the comparisons were made.

DISCUSSION

The investigations were carried out during the 1954 grinding season using two ton lots of cane. The same procedure was followed that has been used during the past investigations - that is - mill speed was

Cane Harvesting and Processing Dates, 1954

TABLE I

VARIETY TESTS

Run No.	Variety	Date Harvested	Date Processed	Delay in Processing (days)	Delivered From
1	CP44-101S	Oct. 18	Oct. 19	1	St. Gabriel
3	CP44-101S	Oct. 18	Oct. 21	3	"
18	CP44-101P	Nov. 13	Nov. 16	3	"
20	CP44-101P	Nov. 15	Nov. 18	3	"
2	CP44-154S	Oct. 19	Oct. 20	1	St. Gabriel
4	CP44-154S	Oct. 19	Oct. 22	3	"
24	CP44-154P	Nov. 30	Dec. 1	1	"
26	CP44-154P	Nov. 30	Dec. 3	3	"
5	CP47-193S	Oct. 25	Oct. 26	1	St. Gabriel
8	CP47-193S	Oct. 25	Oct. 29	4	"
27	CP47-193P	Dec. 4	Dec. 6	2	"
28	CP47-193P	Dec. 6	Dec. 7	1	"
15	CP48-103S	Nov. 8	Nov. 9	1	St. Gabriel
16	CP48-103S	Nov. 8	Nov. 11	3	"
17	CP48-103P	Nov. 13	Nov. 15	2	"
19	CP48-103P	Nov. 15	Nov. 17	2	"
12	N. Co. 310S	Nov. 3	Nov. 4	1	St. Gabriel
13	N. Co. 310S	Nov. 3	Nov. 5	2	"
23	N. Co. 310P	Nov. 29	Nov. 30	1	"
25	N. Co. 310P	Nov. 29	Dec. 2	3	"

regulated at 35 feet/min., maceration at 20% and mill pressure constant.

Also the same characteristics for comparison are used in this report that have been used in preparation of previous reports of these investigations; namely, % sucrose in cane; % sucrose in normal juice; purity of normal juice; sucrose extracted % sucrose in cane; theoretical available 96° sugar per ton cane (90 BHE number); grinding rate, tons/hour; fiber % cane and power consumption, KWH/ton cane.

Table I lists the varieties tested, whether stubble or plant, number of samples tested and number of days processing was delayed after cane was harvested.

In the Appendix, Tables II through VI lists the data for each individual test of each variety and from this data the tables of comparison, that is Tables VII, VIII and IX were developed. Variety CP44-101 is again used as a standard for comparison.

The results shown in Tables VIII and IX are calculated from the averages appearing in Table VII.

By referring to Table VIII, Comparative Rating Table for Samples of Stubble Cane Tested, it is noted that three out of the four varieties have an overall rating better than the standard. They are, first, CP48-103 with 113.07 compared with 100.00 for CP44-101, the standard; second is NCO-310 which has an average 105.00; and third CP47-193 with 100.44. The only variety with an average below the standard is CP44-154 which has an average of 91.44%.

The results in Table IX, that is, Comparative Rating Table for the % of Standard in the Plant Cane Samples, show the varieties in the same order and also three of the four better than the standard. The only difference is that they have a higher percentage. This is caused by the plant cane being better matured when tested.

	Stubble Cane	Plant Cane
CP44-101	100.00%	100.00%
CP48-103	113.07	121.20
NCO-310	105.00	113.67
CP47-193	100.44	110.57
CP44-154	91.44	96.48

Small table below shows the results of same varieties for the years 1952 and 1953:

	1952	1953
CP44-101	100.00	100.00
CP48-103	102.80	106.59
NCO-310	99.56	105.10
CP47-193	93.99	100.88
CP44-154	93.92	94.14

TABLE II
Individual Runs of CP44-101

Growth	Stubble	Stubble	Plant	Plant
Date Harvested	10-18	10-18	11-15	11-15
Date Ground	10-19	10-21	11-16	11-18
Days Deteriorated	1	3	1	3
MILLING DATA				
Trash % Cane	1.00	1.00	3.00	1.00
Grinding Rate, T/Hr.	14.01	15.58	12.47	15.90
Grinding Rate, T.Fiber/Hr.	1.63	1.71	1.62	1.74
Mill Power, KWH/T. Cane	4.37	5.85	6.01	5.21
Mill Power, KWH/T. Fiber	37.50	53.30	46.80	47.62
Mill Power, KWH/T.Suc.Extd.	58.80	74.10	59.88	60.47
Mill Power, KWH/T.A. 96° Sugar	64.31	88.88	78.00	68.75
Maceration % Cane	14.75	26.67	21.46	20.84
Maceration % Fiber	126.00	244.00	184.00	190.00
Normal Juice % Cane	70.94	78.37	88.73	80.60
Dil. Juice Extd. % Cane	82.30	98.40	95.08	95.95
Dil. % Dilute Juice	13.83	20.34	6.69	16.55
Suc. Extd. % Sucrose in Cane	86.50	91.56	91.78	90.70
ANALYTICAL DATA				
Sucrose % Cane	8.63	8.66	9.79	9.48
Fiber % Cane	11.69	10.92	11.64	10.94
Bagasse % Cane	28.55	25.03	26.03	24.88
Sucrose % Bagasse	4.13	2.84	3.07	3.55
Moisture % Bagasse	53.00	52.00	51.00	51.20
Fiber % Bagasse	41.00	43.60	44.75	44.00
Suc. % Fiber in Bagasse	9.97	6.69	6.91	8.06
Crusher Juice, Brix	15.21	15.36	14.65	15.13
Crusher Juice, Sucrose	10.62	10.52	10.72	11.17
Crusher Juice, Purity	69.82	68.44	73.17	73.83
Mixed Juice, Brix	12.70	11.87	13.26	12.25
Mixed Juice, Sucrose	9.08	8.06	9.45	8.96
Mixed Juice, Purity	71.43	67.90	71.26	73.14
Residual Juice, Brix	8.80	6.35	5.44	5.32
Residual Juice, Sucrose	6.05	4.10	3.45	3.90
Residual Juice, Purity	68.75	64.57	71.01	73.31
Normal Juice, Sucrose	10.52	10.12	10.01	10.74
Pur. Drop Crusher to Resid.	1.07	3.87	2.16	0.69
MISCELLANEOUS DATA				
Run Number	1	3	18	20
Shortage in Mat. Bal. %	3.40	2.60	0.30	0.00
3rd. Mill Speed, Ft./Min.	41.00	34.00	33.00	31.00
T.A. 96° Sugar/T. Cane, lbs.	136.00	131.60	154.00	151.60

TABLE III
Individual Runs of CP44-154

Growth	Stubble	Stubble	Plant	Plant
Date Harvested	10-10	10-29	11-30	11-30
Date Ground	10-20	10-22	12-1	12-3
Days Deteriorated	1	3	1	3
MILLING DATA				
Trash % Cane	1.30	1.00	1.00	1.00
Grinding Rate, T/Hr.	14.97	11.36	14.88	11.37
Grinding Rate, T.Fiber/Hr.	2.09	1.60	1.82	1.54
Mill Power, KWH/T. Cane	4.81	5.48	5.90	5.63
Mill Power, KWH/T. Fiber	34.48	38.96	48.30	42.92
Mill Power, KWH/T. Extd.	66.70	82.20	69.44	70.92
Mill Power, KWH/T.A. 96^{o} Sugar	78.86	99.63	77.63	79.80
Maceration % Cane	26.95	30.40	21.59	13.18
Maceration % Fiber	193.00	215.00	177.10	100.00
Normal Juice % Cane	77.14	71.72	78.02	73.97
Dil. Juice Extd. % Cane	96.10	93.40	89.50	81.18
Dil. % Dilute Juice	19.76	23.26	12.81	8.91
Suc. Extd. % Sucrose in Cane	89.88	89.02	88.62	87.26
ANALYTICAL DATA				
Sucrose % Cane	8.08	7.49	9.59	9.07
Fiber % Cane	13.96	14.12	12.18	13.15
Bagasse % Cane	30.90	30.88	28.61	31.26
Sucrose % Bagasse	2.57	2.70	3.82	3.69
Moisture % Bagasse	51.00	50.00	52.00	52.50
Fiber % Bagasse	45.20	45.70	42.60	42.10
Suc. % Fiber in Bagasse	5.86	5.83	8.96	8.78
Crusher Juice, Brix	14.46	14.80	15.61	15.74
Crusher Juice, Sucrose	9.65	9.77	11.40	11.38
Crusher Juice, Purity	66.73	66.01	73.03	72.30
Mixed Juice, Brix	11.25	11.02	13.20	13.90
Mixed Juice, Sucrose	7.56	7.15	9.52	9.77
Mixed Juice, Purity	67.20	64.88	72.12	70.28
Residual Juice, Brix	6.23	5.50	5.98	9.57
Residual Juice, Sucrose	4.26	3.49	4.24	5.02
Residual Juice, Purity	68.37	63.45	70.90	68.68
Normal Juice, Sucrose	9.42	9.31	10.89	10.70
Pur. Drop Crusher to Resid.	0.00	2.56	2.13	3.62
MISCELLANEOUS DATA				
Run Number	2	4	24	26
Shortage in Mat. Bal. %	0.90	4.70	2.86	0.60
3rd. Mill Speed Ft. /Min.	38.00	36.00	38.00	40.00
T.A. 96^{o} Sugar/T. Cane, lbs.	122.00	110.00	152.00	141.20

TABLE IV
Individual Runs of CP47-193

Growth	Stubble	Stubble	Plant	Plant
Date Harvested	10-25	10-25	12-4	12-6
Date Ground	10-26	10-29	12-6	12-7
Days Deteriorated	1	4	2	1
MILLING DATA				
Trash % Cane	3.00	2.50	1.00	1.00
Grinding Rate, T./Hr.	11.76	13.08	11.54	14.04
Grinding Rate, T. Fiber/Hr.	1.46	1.42	1.65	1.79
Mill Power, KWH/T. Cane	5.89	5.86	5.62	5.88
Mill Power, KWH/T. Fiber	47.30	40.40	39.22	46.22
Mill Power, KWH/T. Suc. Extd.	66.67	70.80	49.75	53.66
Mill Power, KWH/T.A. 96° Sugar	72.77	78.90	52.21	57.00
Maceration % Cane	24.21	34.40	31.97	23.12
Maceration % Fiber	194.00	237.00	153.00	182.00
Normal Juice % Cane	71.46	71.56	79.47	77.20
Dil. Juice Extd. % Cane	92.85	99.38	89.89	92.02
Dil. % Dilute Juice	23.03	28.00	11.61	16.11
Suc. Extd. % Sucrose in Cane	88.19	89.33	89.14	89.74
ANALYTICAL DATA				
Sucrose % Cane	9.96	9.26	12.67	12.23
Fiber % Cane	12.44	14.50	14.33	12.73
Bagasse % Cane	29.30	31.81	33.40	30.17
Sucrose % Bagasse	4.10	3.14	4.13	4.20
Moisture % Bagasse	51.50	50.00	51.80	52.30
Fiber % Bagasse	42.40	45.55	42.90	42.20
Suc. % Fiber in Bagasse	9.46	6.82	9.61	9.85
Crusher Juice, Brix	16.88	16.27	18.11	18.30
Crusher Juice, Sucrose	13.40	12.27	14.81	15.03
Crusher Juice, Purity	77.25	75.41	81.78	82.13
Mixed Juice, Brix	12.60	11.36	15.53	14.89
Mixed Juice, Sucrose	9.86	8.31	12.58	11.92
Mixed Juice, Purity	75.08	73.15	81.00	80.05
Residual Juice, Brix	6.84	5.17	6.83	6.43
Residual Juice, Sucrose	4.62	3.65	5.31	4.94
Residual Juice, Purity	67.54	70.60	77.75	76.82
Normal Juice, Sucrose	12.29	11.56	14.21	14.22
Pur. Drop Crusher to Resid	9.71	4.81	4.03	5.31
MISCELLANEOUS DATA				
Run Number	5	8	27	28
Shortage in Mat. Bal. %	1.60	2.40	1.00	0.80
3rd Mill Speed Ft./Min.	32.00	25.00	40.00	38.00
T.A. 96° Sugar/T. Cane, lbs	161.80	148.40	215.00	206.20

TABLE V
Individual Runs of CP48-103

Growth	Stubble	Stubble	Plant	Plant
Date Harvested	11-8	11-8	11-13	11-15
Date Ground	11-9	11-11	11-15	11-17
Days Deteriorated	1	3	2	2
MILLING DATA				
Trash % Cane	1.00	2.00	1.00	1.00
Grinding Rate, T./Hr.	13.95	11.35	13.69	15.22
Grinding Rate, T.Fiber/Hr.	1.81	1.63	1.43	1.67
Mill Power, KWH/T. Cane	6.63	5.43	4.63	5.07
Mill Power, KWH/T. Fiber	51.16	37.83	44.30	46.33
Mill Power, KWH/T. Suc. Extd.	57.00	57.09	37.41	42.10
Mill Power, KWH/T.A. 96° Sugar	59.52	57.19	39.75	44.54
Maceration % Cane	21.09	21.30	16.41	17.75
Maceration % Fiber	162.00	149.00	163.00	162.00
Normal Juice % Cane	78.30	73.07	82.87	82.99
Dil. Juice Extd. % Cane	90.69	86.23	92.72	92.66
Dil. % Dilute Juice	13.92	15.24	10.58	10.44
Suc. Extd. % Sucrose in Cane	88.53	91.66	91.58	90.31
ANALYTICAL DATA				
Sucrose % Cane	13.13	11.62	13.50	13.31
Fiber % Cane	13.00	14.30	10.43	10.97
Bagasse % Cane	30.12	31.77	23.24	26.35
Sucrose % Bagasse	4.96	3.10	4.85	4.94
Moisture % Bagasse	50.80	50.50	49.25	52.20
Fiber % Bagasse	43.10	45.00	44.90	41.60
Suc. % Fiber in Bagasse	11.60	6.77	10.88	11.75
Crusher Juice, Brix	18.96	19.82	18.42	18.19
Crusher Juice, Sucrose	15.57	15.74	15.57	15.11
Crusher Juice, Purity	82.12	79.41	84.52	83.07
Mixed Juice, Brix	15.83	16.30	15.98	15.80
Mixed Juice, Sucrose	12.79	12.34	13.34	12.97
Mixed Juice, Purity	80.80	75.71	83.47	82.09
Residual Juice, Brix	8.89	7.80	7.07	5.92
Residual Juice, Sucrose	7.16	5.40	5.92	4.74
Residual Juice, Purity	80.53	69.23	82.56	80.06
Normal Juice, Sucrose	14.85	14.58	14.92	14.49
Pur. Drop Crusher to Resid.	1.59	10.18	1.96	3.01
MISCELLANEOUS DATA				
Run Number	15	16	17	19
Shortage in Mat. Bal., %	0.00	2.70	0.40	0.00
3rd. Mill Speed Ft./Min.	31.00	35.00	25.00	34.00
T.A. 96° Sugar/T. Cane, lbs.	222.60	189.80	232.80	228.60

TABLE VI
Individual Runs of NCO-310

Growth	Stubble	Stubble	Plant	Plant
Date Harvested	11-3	11-3	11-29	11-29
Date Ground	11-4	11-5	11-30	12-2
Days Deteriorated	1	2	1	3
MILLING DATA				
Trash % Cane	6.50	7.00	1.00	2.00
Grinding Rate, T/Hr.	13.71	10.45	14.50	16.53
Grinding Rate, T.Fiber/Hr.	1.70	1.40	1.60	1.88
Mill Power, KWH/T. Cane	5.61	6.07	5.96	5.13
Mill Power, KWH/T. Fiber	44.94	45.45	53.92	45.04
Mill Power, KWH/T. Suc. Extd.	60.91	63.29	55.83	45.45
Mill Power, KWH/T.A. 96°	66.23	67.11	59.62	54.34
Maceration % Cane	22.80	26.72	20.41	22.38
Maceration % Fiber	154.00	200.00	185.00	197.00
Normal Juice % Cane	78.29	75.43	78.29	86.33
Dil. Juice Extd. % Cane	93.00	95.23	92.93	94.95
Dil. % Dilute Juice	15.80	20.80	15.75	9.89
Suc. Extd. % Sucrose in Cane	89.95	89.00	90.80	91.30
ANALYTICAL DATA				
Sucrose % Cane	10.19	10.82	11.79	12.38
Fiber % Cane	12.45	13.39	11.05	11.38
Bagasse % Cane	28.15	30.37	25.28	26.15
Sucrose % Bagasse	3.65	3.92	4.27	4.14
Moisture % Bagasse	51.00	51.00	50.90	52.00
Fiber % Bagasse	44.20	44.10	43.80	43.60
Suc. % Fiber in Bagasse	8.22	8.84	9.80	9.46
Crusher Juice, Brix	15.60	16.70	17.41	17.21
Crusher Juice, Sucrose	12.48	13.29	14.15	13.99
Crusher Juice, Purity	80.00	79.58	81.27	81.29
Mixed Juice, Brix	12.74	12.83	14.23	15.04
Mixed Juice, Sucrose	9.85	10.11	11.51	11.90
Mixed Juice, Purity	77.32	78.80	80.88	79.12
Residual Juice, Brix	5.38	5.22	6.15	5.75
Residual Juice, Sucrose	4.13	4.14	4.96	4.43
Residual Juice, Purity	76.77	79.31	80.65	77.04
Normal Juice, Sucrose	11.71	12.76	13.67	13.10
Pur. Drop Crusher to Resid.	3.22	0.27	0.62	4.25
MISCELLANEOUS DATA				
Run Number	12	13	23	25
Shortage in Mat. Bal. %	1.30	0.90	1.80	1.00
3rd Mill Speed, Ft./Min.	38.00	32.00	40.00	38.00
T.A. 96° Sugar/T. Cane, lbs.	168.60	181.00	200.00	207.60

TABLE VII
Average Grinding Data Taken From First Two Runs on Each Variety

Variety	CP44-154 Stubble	CP44-154 Plant	CP47-193 Stubble	CP47-193 Plant
MILLING DATA				
Trash % Cane	1.10	1.00	2.70	1.00
Grinding Rate, T./Hr.	13.17	13.31	12.42	12.79
Grinding Rate, T.Fiber/Hr.	1.85	1.68	1.44	1.72
Mill Power, KWH/T. Cane	5.15	5.77	5.88	5.75
Mill Power, KWH/T. Fiber	36.72	45.61	43.85	42.72
Mill Power, KWH/T. Suc.Extd.	74.45	70.18	68.74	51.70
Mill Power, KWH/T.A.96° Sugar	89.25	78.72	75.84	54.61
Maceration % Cane	28.67	17.39	29.30	22.54
Maceration % Fiber	204.00	138.00	215.00	168.00
Normal Juice % Cane	74.43	76.00	71.51	78.34
Dil. Juice extd. % Cane	94.75	85.34	96.12	90.96
Dil. % Dilute Juice	21.51	10.86	25.51	13.86
Suc. Ext. % Suc. in Cane	89.45	87.94	88.76	89.44
ANALYTICAL DATA				
Sucrose % Cane	7.79	9.33	9.61	12.45
Fiber % Cane	14.04	12.67	13.47	13.53
Bagasse % Cane	30.89	29.94	30.56	31.79
Sucrose % Bagasse	2.63	3.76	3.62	4.16
Moisture % Bagasse	50.50	52.20	50.70	52.00
Fiber % Bagasse	45.50	42.30	44.00	42.50
Suc. % Fib. in Bagasse	5.85	8.87	8.14	9.73
Crusher Juice, Brix	14.63	15.68	16.58	18.20
Crusher Juice, Sucrose	9.71	11.39	12.66	14.92
Crusher Juice, Purity	66.37	72.66	76.33	81.96
Mixed Juice, Brix	11.14	13.55	11.98	15.21
Mixed Juice, Sucrose	7.35	9.64	8.89	12.25
Mixed Juice, Purity	66.04	71.20	74.12	80.53
Residual Juice, Brix	5.87	7.78	6.01	6.63
Residual Juice, Sucrose	3.88	4.63	4.14	5.12
Residual Juice, Purity	65.91	69.79	69.07	77.29
Normal Juice, Sucrose	9.36	10.80	11.93	14.21
Pur. Drop Crusher to Resid.	0.46	2.87	7.26	4.67
MISCELLANEOUS DATA				
Shortage in Mat. Bal., %	2.30	1.70	2.00	0.90
3rd Mill Speed, Ft./Min.	37.00	39.00	29.00	39.00
T.A. 96° Sugar/T.Cane, lbs.	116.00	146.60	155.10	210.60

TABLE VII (Cont.)

Average Grinding Data Taken From First Two Runs on Each Variety

Variety	CP44-101 Stub.	CP44-101 Plant	NCO-310 Stub.	NCO-310 Plant	CP48-103 Stub.	CP48-103 Plant
MILLING DATA						
Trash % Cane	1.00	2.00	6.75	1.50	1.50	1.00
Grinding Rate, T/hr.	14.80	14.19	12.08	15.52	12.65	14.46
Grinding Rate, T. Fiber/Hr.	1.67	1.68	1.55	1.73	1.72	1.55
Mill Power, KWH/T. Cane	5.11	5.61	5.84	5.55	6.03	4.85
Mill Power, KWH/T. Fiber	45.40	46.85	45.20	49.48	44.50	45.32
Mill Power, KWH/T. Fiber	45.40	46.85	45.20	49.48	44.50	45.32
Mill Power, KWH/T. Suc. Extd.	66.45	60.18	62.10	50.64	54.05	39.76
Mill Power, KWH/T. A. 96° Sug.	76.60	73.37	66.67	56.98	58.36	42.15
Mill Power, KWH/T. A. 96° Sug.	76.60	73.37	66.67	56.98	58.36	42.15
Maceration % Cane	20.17	21.15	24.76	21.40	21.20	17.08
Maceration % Fiber	185.00	187.00	177.00	191.00	156.00	163.00
Normal Juice % Cane	74.66	84.40	76.86	82.31	75.69	82.93
Dil. Juice Extd. % Cane	90.35	95.52	94.12	93.94	88.46	92.69
Dil. % Dilute Juice	17.08	11.62	18.30	12.82	14.58	10.51
Suc. Extd. % Suc. in Cane	89.03	91.24	89.48	91.05	90.10	90.95
ANALYTICAL DATA						
Sucrose % Cane	8.65	9.64	10.51	12.09	12.37	13.40
Fiber % Cane	11.31	11.29	12.92	11.22	13.95	10.65
Bagasse % Cane	26.79	25.46	29.26	25.72	30.94	24.80
Sucrose % Bagasse	3.49	3.31	3.79	4.21	4.03	4.90
Moisture % Bagasse	52.50	51.10	51.00	51.40	50.70	50.70
Fiber % Bagasse	42.30	44.38	44.10	43.70	44.00	43.30
Suc. % Fiber in Bagasse	8.33	7.49	8.53	9.63	9.19	11.32
Crusher Juice, Brix	15.29	14.89	16.15	12.31	19.39	18.30
Crusher Juice, Sucrose	10.57	10.95	12.89	14.08	15.66	15.34
Crusher Juice, Purity	69.13	73.52	79.79	81.28	80.77	83.80
Mixed Juice, Brix	12.28	12.76	12.79	14.63	16.07	15.89
Mixed Juice, Sucrose	8.57	9.21	9.98	11.71	12.57	13.15
Mixed Juice, Purity	69.66	72.20	78.06	80.00	78.26	82.78
Residual Juice, Brix	7.58	5.38	5.30	5.95	8.35	6.50
Residual Juice, Sucrose	5.08	3.68	4.14	4.70	6.28	5.33
Residual Juice, Purity	66.66	72.08	78.04	78.85	75.20	81.31
Normal Juice, Sucrose	10.32	10.38	12.24	13.38	14.72	14.71
Pur. Drop Crusher to Resid.	2.47	1.44	1.75	2.43	5.57	2.49
MISCELLANEOUS DATA						
Shortage in Mat. Bal. %	3.00	0.15	1.10	1.40	1.30	0.20
3rd Mill Speed, Ft./Min.	37.50	32.00	35.00	39.00	33.00	30.00
T.A. 96° Sugar/T. Cane, lbs.	133.80	152.80	174.80	203.80	206.20	230.70

TABLE VIII

Comparative Rating Table--% of Standard for Stubble Cane

Variety	CP 44-101	NCO 310	CP 48-103	CP 44-154	CP 47-193
Sucrose % Cane	8.65	10.51	12.37	7.79	9.61
% Standard	100.00	121.50	143.00	90.05	111.10
Sucrose % Normal Juice	10.32	12.24	14.72	9.36	11.93
% Standard	100.00	118.60	142.64	90.70	115.60
Purity Normal Juice	69.66	78.06	78.26	66.04	74.12
% Standard	100.00	112.05	112.35	94.80	106.40
Suc. Ext. % Suc. in Cane	89.03	89.48	90.10	89.45	88.76
% Standard	100.00	100.50	101.20	100.47	99.70
T.A. 96°Sugar lbs./T.Cane	133.80	174.80	206.20	116.00	155.10
% Standard	100.00	130.64	154.11	86.70	115.92
Grinding Rate T./Hr.	14.80	12.08	12.65	13.17	12.42
% Standard	100.00	81.62	85.47	88.99	83.92
Fiber % Cane	11.31	12.92	13.95	14.04	13.47
% Standard	100.00	87.54	81.08	80.56	83.96
Power Consumption KWH/ T. Cane	5.11	5.84	6.03	5.15	5.88
% Standard	100.00	87.50	87.74	99.22	86.90
Totals	800.00	839.95	904.59	731.49	803.50
Avg. Overall Rating	100.00	105.00	113.07	91.44	100.44

TABLE IX

Comparative Rating Table -- % of Standard for Plant Cane

Variety	CP 44-101	NCO 310	CP 48-103	CP 44-154	CP 47-193
Sucrose % Cane	9.64	12.09	13.40	9.33	12.45
% Standard	100.00	125.41	139.00	96.78	129.15
Sucrose % Normal Juice	10.38	13.38	14.71	10.80	14.21
% Standard	100.00	128.90	141.71	104.05	136.90
Purity Normal Juice	72.20	80.00	82.78	71.20	80.53
% Standard	100.00	110.80	114.65	98.61	111.54
Suc. Extd. %Suc. in Cane	91.24	91.05	90.95	87.94	89.44
% Standard	100.00	99.79	99.68	96.36	98.03
T.A. 96°Sugar lbs/T.Cane	152.8	203.8	150.98	146.60	210.6
% Standard	100.00	133.38	150.98	95.94	137.82
Grinding Rate	14.19	15.52	14.46	13.31	12.79
% Standard	100.00	109.37	101.90	93.80	90.13
Fiber % Cane	11.29	11.22	10.65	12.67	13.53
% Standard	100.00	100.62	106.00	89.11	83.44
Power Consumption, KWH/ T. Cane	5.61	5.55	4.85	5.77	5.75
% Standard	100.00	101.08	115.67	97.23	97.57
Totals	800.00	909.35	969.59	771.88	884.58
Avg. Overall Rating	100.00	113.67	121.26	96.48	110.57

A PRELIMINARY REPORT ON SOME FERTILIZER EXPERIMENTS AT RESERVE

By L. G. Joyner and Malcolm Lasseigne

This will report on a fertilizer experiment which was intended to be an applied check on the effect of complete fertilizer vs. only nitrogen such as has been described by Sturgis and Byrnside (1). Unfortunately the results were completely negative. In spite of this a great deal was learned about how such tests should be carried out and this is the only excuse for presenting the paper at this time. It will also help to emphasize that just because a farmer obtains negative results in his first trials he should not jump to the conclusion that Sturgis and Byrnsides' ten years of study on the subject will not work in his case. If one knew all the variables, an explanation could undoubtedly be made for all negative results.

The experiment started off with the idea of testing the effect of complete fertilization along with the following variables, nitrogen level, heavy vs. sandy soil, and maturity of cane. Thus the first error was that too many variables were included in the test. This was actually realized but we were curious to see whether an effect could be found.

Two blocks of first year stubble were selected, one in a sandy soil area (Mhoon alluvial silt) and the other in black soil (Sharkey alluvial silt). Each block was divided into 12 plots of approximately one acre each. Two of the plots in each block were fertilized with nitrogen (ammonium nitrate) at 75#/acre, two at 90 and two at 110. Two more were given a complete fertilizer of 75-40-60 (K with 60% muriate of potash, P from 20% superphosphate). A similar complete fertilizer was applied to two plots each at the 90 and 110 nitrogen level. In each block one of the complete sets was harvested early and the second set about a month later. The cane variety on sandy soil was CP36-105 and on the black soil CP44-101.

Before applying the fertilizer, a complete soil analysis was made on both blocks. Eleven samples of soil were collected in a criss cross patter from each block. Each sample consisted of five 18" cores which were thoroughly ground and mixed before sampling. The results of the soil analysis are shown in Table I.

TABLE I - SOIL ANALYSIS

	Mhoon (Sandy)				Sharkey (Black)			
	N %	K ppm	P ppm	pH	N %	K ppm	P ppm	pH
Maximum	0.109	314	490	7.3	0.141	472	1390	6.5
Minimum	0.075	133	288	6.4	0.095	169	356	6.0
Average of 11 samples	0.094	246	349	6.7	0.116	383	597	6.3

These values are somewhat higher than the usual analysis on similar soils but it is characteristic for the Sharkey soil to be higher in plant nutrients than the Mhoon. Complete rotation had been followed in these fields which may explain their high nutrient level. The relative pH is opposite to the usual order found in these soils but this does not appear to be a factor in cane culture.

The cane, juice analysis, and sugar yields at the various nutrient levels are shown in Tables II, III, IV and V. Each table covers a single harvesting.

As has been indicated, these results show almost no distinct trend. This is a difficulty inherant in an experiment in which too many variables have been changed. It serves, however, to point up the importance of making several replicate tests in any soil or fertilizer experiment.

If the fact that the four harvestings differed in several respects is ignored, they can be treated as though they were replicate plantings and the fertilizer effect averaged out. When this is done one finds that the plots given a 75-40-60 fertilization averaged 148 pounds/acre more sugar than those given only 75 pounds of nitrogen. At the 90 pound nitrogen level only 42 pounds/acre increase is found in the completely fertilized fields, which at the 110 pounds/acre level a decrease of 145 pounds of sugar is observed. It would be a serious mistake to consider this to be a trend, since the individual gains and losses are so large as to make the comparison of the averages non-significant.

Rather than jumping to the conclusion at this point that complete fertilization doesn't work one must try to find why the expected response did not show up.

Agronomist have found that 25 net tons of sugar cane requires a total of 6.9 pounds of phosphorous during its growing season. The lower valued Mhoon silts showed an average analysis of 349 ppm of phosphorous before any fertilizer had been added. Since there is approximately two million pounds of soil in the furrow slice from an acre, the phosphorous content of such a slice in that particular block would contain 349 x 2 = 698 pounds per acre. Approximately 3% of this is available to the cane over its growing season or 698 x 0.03 = 21.06 pounds. Thus the cane had available to it three times its phosphorous requirement without the addition of any fertilizer. Hence the addition of more of this nutrient could not be expected to have an effect on the cane.

Similarly 25 tons of cane requires 101 pounds of potassium over its season. Our poorest block already contained 246 ppm of this nutrient so the furrow slice had 2 x 246 = 492 pounds available. Since potassium is soluble, it can all be leached out of the soil so all of the 492 pounds is available to the cane. Thus there was already present in the soil over four times the required quantity of this nutrient. Even if the lowest quantity of potassium and phosphorous shown in Table I were used in such calculations, these would still be more than twice the required nutrients. Thus, since the soil was already sufficiently high in these two

TABLE II
Response to Fertilizers from CP44-101, 1st year stubble, Sharkey, Early Harvest

Lbs. /acre nutrients	Gross T / Acre	% Trash	Brix	Su-crose	Purity	Net T. / Acre	# Sugar / Acre
75-0-0	27.70	2.80	16.19	12.27	75.79	26.92	4277
75-40-60	28.39	6.86	16.19	12.28	75.85	26.44	4207
90-0-0	31.20	6.00	16.22	11.99	75.44	29.33	4539
90-40-60	29.37	12.80	15.74	11.91	75.67	25.61	3946
110-0-0	31.19	3.90	16.03	11.95	74.55	29.97	4588
110-40-60	35.01	6.08	16.06	11.92	74.22	32.88	5009

TABLE III
Response to Fertilizers from CP44-101, 1st year stubble, Sharkey, Late Harvest

Lbs. /acre Nutrients	Gross T / Acre	% Trash	Brix	Su-crose	Purity	Net T. / Acre	# Sugar / Acre
75-0-0	25.39	5.44	17.24	13.34	77.38	24.01	4199
75-40-60	25.82	8.75	17.64	13.55	76.81	23.56	4166
90-0-0	24.60	4.87	17.06	13.29	77.90	23.40	4092
90-40-60	31.03	3.54	16.86	12.63	74.91	29.93	4859
110-0-0	29.26	3.54	16.86	12.63	74.91	28.22	4582
110-40-60	24.71	13.87	16.83	12.87	76.47	21.28	3566

TABLE IV
Response To Fertilizers from CP36-105, 1st year Stubble, Mhoon, Early Harvest

Lbs. /Acre Nutrients	Gross T. / Acre	% Trash	Brix	Su-crose	Purity	Net T. / Acre	# Sugar /Acre
75-0-0	26.25	11.27	16.34	11.89	72.77	23.29	3496
75-40-60	22.99	4.15	16.52	12.35	74.76	22.04	3493
90-0-0	25.07	4.76	14.84	10.80	72.78	23.88	3256
90-40-60	26.84	2.41	14.54	10.99	75.58	26.19	3721
110-0-0	24.27	5.23	15.06	11.16	74.10	23.00	3278
110-40-60	24.04	4.52	14.60	10.71	73.36	22.95	3120

TABLE V
Response to Fertilizers from CP36-105, 1st year stubble, Mhoon, Late Harvest

Lbs. /Acre Nutrients	Gross T. / Acre	% Trash	Brix	Su-crose	Purity	Net T. / Acre	# Sugar / Acre
75-0-0	24.06	5.38	17.80	13.87	77.92	22.77	4156
75-40-60	28.27	3.49	17.74	13.63	76.83	27.28	4853
90-0-0	26.64	4.17	17.90	14.01	78.28	25.53	4720
90-40-60	24.63	3.45	18.10	13.72	75.80	23.78	4224
110-0-0	25.20	3.18	17.86	13.86	77.60	24.40	4440
110-40-60	26.18	3.18	17.86	13.86	77.60	25.35	4613

minerals, the use of a complete fertilizer could not be expected to show any marked effect on the cane yield.

Since it can be shown that in this particular case the use of a complete fertilizer is unnecessary, the question of the value of nitrogen may arise. Studies have shown that an extra ton of cane per acre will result from the addition of from 6 to 10 lbs. of nitrogen. Comparison of the average of the four plots fertilized at 75 pounds of nitrogen alo with the average of the four at the 110 pound level shows an increase of slightly over two tons per acre at the higher level. This is somewhat lower than might be expected from the additional 35 pounds of nitrogen but it is in the right direction and the low rainfall of last spring and summer may account for the incomplete response.

Although no conclusions can be drawn from these tests, they do point out how a detailed soil analysis can help the farmer select the proper type of fertilizer application. In spite of the negative results, further tests will be carried out. A repeat application a the same nutrient level will be made on these same plots to see whether a greater effect may not show up in the second year stubble. Little effect, howeve is expected. Blocks with similar high phosphorous and potassium conten will be fertilized at various nitrogen levels. In this case a number of replicate plots will be made. Soils in poorer growing areas will be analyzed to find if the phosphorous and potassium content may be low. On such it is expected that a greater effect will be shown by complete fertilization.

Reference:
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PROCEEDINGS

American Society of Sugar Cane Technologists

Volume 6

January, 1959

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F O R E W O R D

This is the sixth volume of proceedings of the Society which have been published since its founding in 1938.

The first volume published in 1941 included papers presented during 1938, 1939 and 1940. Mr. Walter Godchaux, Jr., the then Secretary-Treasurer edited that edition.

The second volume published in 1946 included papers presented during the period 1941-1945 inclusive. Dr. E. V. Abbott, Secretary-Treasurer, edited that volume.

The third volume published in 1953 included papers presented during 1946-1950 inclusive. The fourth volume included papers presented during 1951, 1952 and 1953. The fifth volume included papers presented during 1954 and 1955. This the sixth volume includes papers presented during 1956. The last four volumes including the present one were edited by the writer.

Arthur G. Keller

Secretary-Treasurer

January 1959

I N D E X

Manufacturing Section

Agricultural Section

The Value of Fresher Sugarcane

to

Both Growers and Processors

By W. F. Guilbeau, E. E. Coll and L. F. Martin
Southern Regional Research Laboratory 1/
New Orleans, Louisiana

Fresh, hand-cleaned sugarcane that was ground within 24 hours after cutting was shown to be worth $42 per acre more, on the average, than cane left in leap rows for 9 days before grinding in the pilot plant at the Audubon Factory in experiments carried out during the 1954 season (1,2). Similar experiments were carried out during the 1955 season on eight separate lots of cane grown at St. Gabriel Plantation. These experimentns were planned to be more comparable to current harvesting practices. The cane was to be burned, and relatively fresh samples ground on the second and third days were compared with samples taken seven and approximately ten days after cutting, rather than nine and fourteen day old cane used in the earlier work. Only two of the eight lots of cane could be cleaned by burning in the heap rows, as the others were too near the standing cane. The cane that could not be burned contained a high percentage of trash. The procedure was the same as in the earlier experiments except for these changes.

The additional return of at least $5 per acre realized for each day saved in getting harvested cane to the mills was confirmed by results of these experiments. The saving equalled that estimated in 1954, even though cane matured late and purities were lower in the 1955 crop. This increased return can be obtained by growers. Equally substantial gains can be realized by the factories from more efficient processing of the higher quality cane. There was marked improvement in commercial handling of cane during the 1955 season, when nearly all mills received fresher cane and were able to obtain satisfactory recoveries of sugar in spite of the low purities.

1/ One of the laboratories of the Southern Utilization Research Branch, Agricultural Research Services, U. S. Department of Agriculture.

Results

The eight lots of cane included both plant and stubble of the three new varieties released most recently, and of the most widely grown variety, C.P. 44-101. They are representative of the kind of cane that will be grown and processed commercially for the next 5-10 seasons. Temperatures, rainfall, and humidity to which each lot of cane was exposed were generally favorable, as seen in Figure 1. The average, overall result of keeping the cane longer in field heap row is given by the upper curve of Figure 2, showing the loss of recoverable sugar for which growers are paid. The average loss amounts to 15% of the recoverable sugar in 5 days after cutting, and reaches almost 22% in about 8-1/2 days. This is caused by the combination of loss in weight, decrease in sucrose, and the drop in purity resulting largely from inversion. Average weight losses given in Table III are 8% of the freshly harvested weight after five days, and over 10% after 8-1/2 days in the heap rows. The drop in purity, shown by the lower curve of Figure 2, was from 69.2 to only 65.4, and 63.8 in five and 8-1/2 days, respectively. The 5-9 day old samples would have only salvage cane value for the lower purities. Sucrose percent cane dropped from 9.7% to 9.27%, and finally to 9.1% in the course of these experiments.

The most significant conclusion from these experiments is the computation in dollars and cents of the return that would be realized from 100 tons of the fresh cane delivered promptly, compared with the return from the reduced weight delivered after the cane has remained in the field 5 days and 8-1/2 days longer. The differences shown in Table IV amount to $134 more per 100 tons for fresh cane compared with the 5-day older cane, and to $156 more per 100 tons compared to the return from cane 8-1/2 days older. On an average stand of 25 tons per acre the extra return that would be realized by prompt delivery would be $39 per acre more than for cane delivered 8-9 days later. This amount is very nearly the same as the gain of $42 per acre for a similar stand harvested and held in the field for approximately the same length of time in the experiments carried out during the 1954 season.

Experimental Details

The four lots of stubble cane were cut during the first half of the season up to November 8, and four lots of plant cane were cut during the latter half of the season from November 15 to December 6. Because of the proximity of standing cane, it was possible to clean only one lot of stubble cane and one lot of plant cane by burning. The other lots were not cleaned. A sub-sample of about 150 lbs. was spread between stakes in the heap row to be weighed accurately each time that a 2-ton sample from the lot of

was cleaned by burning. Temperatures and humidity remained high during the experiments with one unburned and the burned lot of plant cane, but the last plant cane experiment was made during drier weather when temperatures had fallen again with sub-freezing minima on three days during the time that the experiment was in progress.

Weather conditions covered the range experienced in an average, normal season. Curves at the top of Figure 1 show the loss in weight of the cane, expressed as the percentage of the weight remaining in the 150-lb. sub-sample for each experiment. Between 10-15% of the weight was lost in the course of the experiments with all of the lots of unburned cane. This would be expected because of the loss of moisture and respiration from adhering leaves. Loss of weight by the burned stubble cane was less for two reasons; there was appreciable loss of weight during burning which is not determined because the sub-sample was weighed only after burning, therefore less loss could occur subsequently; and the burned samples were free of leafy material that loses weight most rapidly. This was true particularly of the stubble cane that was burned during hot, dry weather with leaves and trash thoroughly removed. The one plant cane sample that was cleaned had been imperfectly burned, and lost more weight rapidly at the beginning of the experiment, after which it was exposed during a period of heavy rainfall and relatively high humidity.

The 2-Ton samples were milled in the Audubon tandem and the juices were clarified continuously on a pilot plant scale by the procedures that have been described previously for the evaluation for milling and processing of different kinds and qualities of cane (3,4). Results of the milling experiments will be the subject of a separate report by Professor Keller, from which the data on extraction, mixed juice Brix, and normal juice purity have been taken for the calculation of recoverable sugar given in Table III. Factors established for the Audubon Mill were used, together with the actual extraction determined for each sample, as a basis for the recoverable sugar calculation.

Complete data on the clarification of juices from the 2-ton samples of cane are assembled in Tables I and II. The effect of delay in milling upon quantities of mud and clarities varied considerably in these experiments, but the average clarities and mud are not significantly different for old samples compared to fresh samples of cane. There was an increasing trend in both mud quantities and clarities. The drop in purity, plotted as average values for the eight experiments in Figure 2, is the principal factor other than loss of weight in reducing the recoverable sugar. It is quantitatively more important than the decrease in sucrose content in impairing the quality and reducing the value of cane that is not ground as promptly

cane was delivered for milling. This provided an approximate measure of the loss in weight of cane in the heap row. The older samples represent delays of five days and about 8-1/2 days longer than the minimum time of delivery that is feasible in practice when cane is cleaned by burning. The two bundles of fresh cane from each lot were delivered together to the Audubon Mill on the second day, and one was milled that day, about 48 hours after cutting, while the second was milled the next day, about 72 hours after cutting. The weight of the 150-lb. sub-sample was taken at St. Gabriel Plantation on the third day after cutting, but this weight has not been applied to the 3-day old bundle of cane that was kept an extra day in the yard of the Audubon Mill. Weights of both the 2nd and 3rd day samples are taken as a standard ton as the basis for calculation of milling and processing results and determination of recoverable sugar; that is, the 3-day old samples are not discounted for loss of weight.

There was no extremely adverse weather during the season, but there was considerable variation in conditions to which different lots of cane were exposed in the heap rows. The conditions prevailing during each experiment are recorded in Figure 1. The first two experiments with stubble cane were completed by November 4 during a period of generally warm and unusually dry weather, Daily variations in temperature were from prevalent minima between 40°-50°, and maxima above 80°. There was no rainfall, with minimum daytime humidities most frequently observed in the unusually low range between 20-30% relative humidity. The cane was not burned in these two experiments. Cane was burned for the third experiment with stubble, and this lot was also affected by the heavy rainfall of November 6. Higher humidities and lower temperatures prevailed during the latter half of the time that this cane remained in the heap row, when 7-and 11-day old samples were collected for milling. Fresh cane samples from the fourth lot of stubble cane were collected during this cool, humid period before November 10, but the older samples from this lot were delivered after temperatures had risen during a period of very humid weather with additional rainfall on November 13.

The first lot of plant cane was cut on November 15, when the weather was still warm and humid, and was later subjected to the first freeze experienced at St. Gabriel, followed by rising temperatures and relatively low humidity. There was more rainfall during the latter part of the season, when the last three experiments were made with plant cane. One of these lots of plant cane, cut on November 29, was burned, while the other two were not cleaned by burning. The heaviest rainfall of the season, 1.7 inches on December 5, affected the last sample taken from the lot of cane that

as possible after cutting and burning.

It is unfortunate that the location of the cane available for the experiments was such that six of the eight lots used for the experiments could not be burned. Only one lot of cane was burned thoroughly, and a second could be burned only partially during the rainy weather late in the season. The average loss of recoverable sugar subsequent to burning was less for these two lots of cane than the average loss in the six experiments with unburned, trashy cane ground at the same lengths of time after cutting. These results cannot be compared because the cleaned cane lost sugar in the burning operation, which the unburned cane did not lose. Experiments should be carried out to determine the loss of recoverable sugar as a result of burning. The largest gain will be realized by grinding only unburned, clean, fresh cane such as the combination harvester-cleaner-loader can deliver within 24 hours.

Acknowledgement

Cane for the experiments was provided by the American Sugar Cane League under the direction of Mr. Lloyd Lauden. We are paricularly indebted to Capt. L. E. Chambers, whose interest in caring for the cane and supervising determinations of weights and the deliveries from St. Gabriel Plantation assured the success of the work, and to Mr. W. S. Chadwick, of J. Supples Sons, for providing scales for weighing the sub-samples. Cane was milled at the Audubon Sugar Factory under a research contract with Louisiana State University, and the assistance of Professor Keller and his staff in all phases of the work is gratefully acknowledged.

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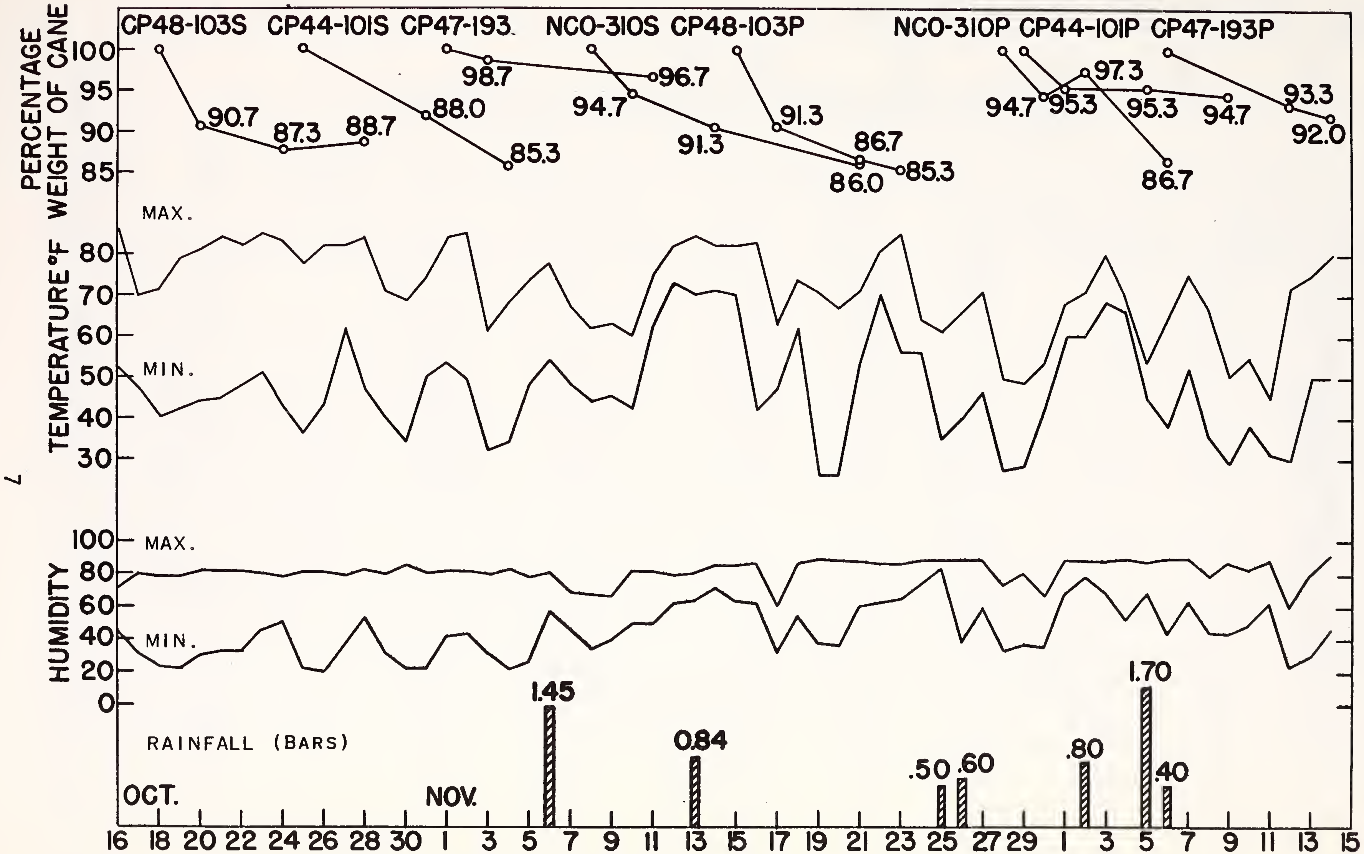

FIG. I-WEATHER CONDITIONS DURING 1955 GRINDING SEASON

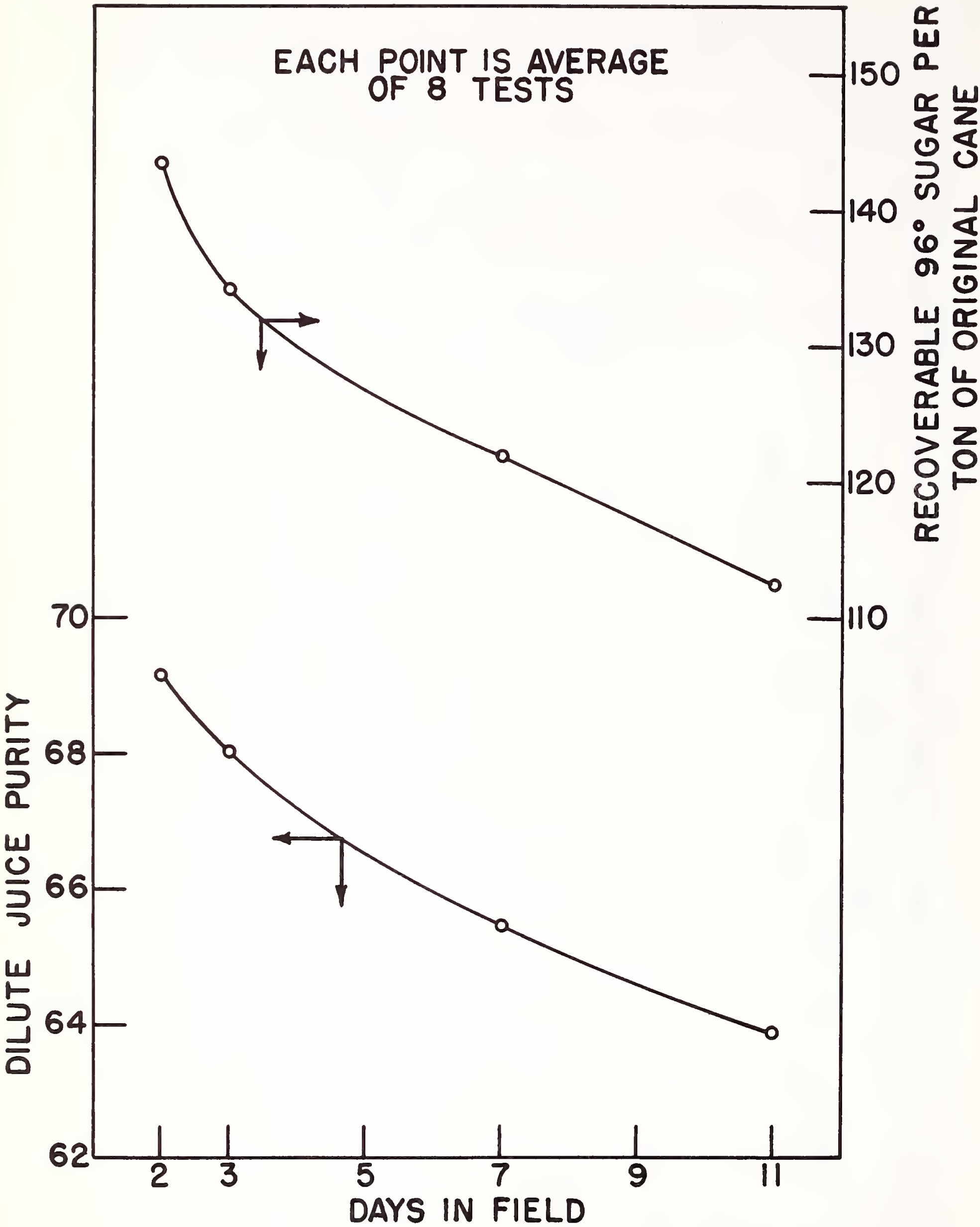

FIG.2 1955 DELAYED MILLING COMPARISONS OF DILUTE JUICE PURITIES AND SUGAR RECOVERIES

TABLE I.
1955 DELAYED MILLING AND PROCESSING EXPERIMENTS
CLARIFICATION CONDITIONS AND PROCESSING RESULTS

Run No.	Date Harvested	Days in Field	Trash % of Cane	Susp.Soil Dil.Juice lbs./T.Cane	Dilute Juice pH	Limed Juice pH	Defecated Juice pH	Defecated Juice Clarity[1]	Juice Purities Dilute	Juice Purities Defecated
1	10-17		4.0	1.22	5.70	7.30	6.60	45	73.2	75.3
4	10-24		6.0	1.38	5.75	7.35	6.60	34	63.6	65.7
8	10-31		1.0	1.10	5.40	7.30	6.60	53	68.9	70.4-Burned
12	11-7		3.0	5.59	5.65	7.35	6.65	39	66.9	71.6
16	11-14		10.0	5.57	5.50	7.30	6.65	35	72.3	75.2
21	11-26		8.0	4.64	5.65	7.35	6.60	29	70.1	73.1
23	11-28		3.0	1.65	5.75	7.30	6.65	43	69.9	71.5-Burned
28	12-5		8.7	9.31	5.65	7.25	6.70	38	68.3	72.6
Average		2	5.5	3.81	5.65	7.30	6.65	40	69.2	71.9
2	10-17		1.5	1.42	5.65	7.30	6.60	41	71.3	73.1
5	10-24		5.0	1.50	5.65	7.50	6.65	40	63.1	64.6
9	10-31		1.5	1.31	5.30	7.40	6.65	53	68.7	70.9-Burned
13	11-7		11.0	6.74	5.65	7.40	6.60	35	65.8	71.1
17	11-14		8.0	4.39	5.60	7.25	6.65	32	72.3	75.1
22	11-26		6.0	4.37	5.75	7.35	6.65	21	66.6	69.9
24	11-28		3.3	2.54	5.70	7.30	6.65	44	68.0	71.4-Burned
29	12-5		8.7	8.46	5.60	7.20	6.65	37	68.2	72.7
Average		3	5.6	3.84	5.60	7.35	6.65	38	68.0	71.1

TABLE I (Continued)
1955 DELAYED MILLING AND PROCESSING EXPERIMENTS
CLARIFICATION CONDITIONS AND PROCESSING RESULTS

Run No.	Date Harvested	Days in Field	Trash % of Cane	Susp. Soil Dil. Juice lbs./T. Cane	Dilute Juice pH	Limed Juice pH	Defecated Juice pH	Defecated Juice Clarity[1]	Juice Purities Dilute	Juice Purities Defecated
3	10-17	7	3.0	1.92	5.65	7.35	6.60	38	63.3	65.0
7	10-24	7	4.0	1.36	5.70	7.40	6.60	41	55.8	58.2
11	10-31	7	3.0	2.35	5.50	7.35	6.70	56	65.6	68.2-Burned
15	11-7	7	7.0	6.57	5.65	7.40	6.60	7	56.6	59.0
19	11-14	7	8.0	5.57	5.65	7.25	6.65	48	71.7	73.6
25	11-26	6	10.0	3.79	5.75	7.30	6.70	27	70.4	73.3
26	11-28	7	6.0	2.65	5.60	7.25	6.65	37	67.8	69.5-Burned
31	12-5	7	10.0	6.79	5.65	7.20	6.60	50	72.2	75.1
Average		7	6.4	3.88	5.65	7.30	6.65	38	65.4	67.7
6	10-17	11	6.0	2.25	5.65	7.30	6.65	46	60.2	62.0
10	10-24	11	5.0	1.57	5.70	7.40	6.65	42	55.0	58.9
14	10-31	11	3.0	6.70	5.55	7.35	6.70	58	64.3	68.4-Burned
18	11-7	11	5.0	7.40	5.65	7.40	6.65	32	61.1	66.0
20	11-14	9	7.5	4.98	5.50	7.25	6.60	64	67.0	69.9
27	11-26	11	10.0	4.57	5.60	7.25	6.65	23	65.6	66.1
30	11-28	11	5.0	2.13	5.40	7.20	6.65	45	68.5	69.3-Burned
32	12-5	9	6.0	6.63	5.60	7.15	6.65	45	69.0	73.3
Average		10.4	5.9	4.53	5.60	7.30	6.65	44	63.8	66.7

[1] Adjusted to 14.0 Brix as Standard.

TABLE II.
1955 DELAYED MILLING AND PROCESSING EXPERIMENTS
LIME REQUIREMENTS AND MUD QUANTITIES

Run No.	Days in Field	Lime Requirement, Lbs/T. Cane	Dry Solids, Wt.% of Mud	Mud Produced, Lbs/T.Cane Wet	Mud Produced, Dry Solids Actual	Mud Produced, Dry Solids Corrected[1]	Dry Solids Analyses Wt. % Mineral	Dry Solids Analyses Wt. % Organic	Filt, Gal. /100SqFt Per Hr.	Settling, Vol % Mud After 1 Hr.
1		0.70	5.04	120	6.05	4.83	31.4	68.6	103	12.0
4		0.97	6.45	116	7.48	6.10	35.2	64.8	98	16.0
8[2]		1.32	4.71	142	6.69	5.59	36.1	63.9	125	16.5
12		0.79	9.77	130	12.70	7.11	52.3	47.7	75	14.5
16		1.55	9.01	134	12.07	6.50	53.1	46.9	41	17.5
21		1.18	7.64	154	11.77	7.13	44.1	55.9	62	17.5
23[2]		1.42	5.29	144	7.62	5.97	37.3	62.7	75	14.0
28		1.52	11.51	147	16.92	7.61	61.7	38.3	70	18.1
Average 2		1.18	7.43	136	10.16	6.36	43.9	56.1	81	15.8
2		0.78	5.60	106	5.94	4.52	33.4	66.6	98	19.0
5		1.14	5.58	134	7.48	5.98	36.3	63.7	87	20.0
9[2]		1.39	5.13	159	8.16	6.85	34.0	66.0	143	16.5
13		0.89	11.49	122	14.02	7.28	56.0	44.0	71	17.0
17		1.38	8.73	121	10.56	6.17	47.9	52.1	54	17.5
22		0.95	9.56	102	9.75	5.38	46.5	53.5	129	14.0
24[2]		1.46	6.38	135	8.61	6.07	44.3	55.7	83	16.5
29		1.53	10.79	151	16.29	7.83	58.8	41.2	70	21.0
Average 3		1.19	7.91	129	10.10	6.26	44.6	55.4	92	17.7

TABLE II (Continued)
1955 DELAYED MILLING AND PROCESSING EXPERIMENTS
LIME REQUIREMENTS AND MUD QUANTITIES

Run No.	Days in Field	Lime Requirement, Lbs/T. Cane	Dry Solids. Wt. % of Mud	Mud Produced, Lbs/T. Cane Wet	Dry Solids Actual	Dry Solids Corrected 1/	Dry Solids Analyses Wt. % Mineral	Dry Solids Analyses Wt. % Organic	Filt, Gal. /100SqFt Per Hr.	Settling Vol % Mud After 1 Hr.
3		1.03	5.87	132	7.75	5.09	34.4	65.6	92	12.0
7		1.25	5.31	157	8.34	6.14	32.1	67.9	83	21.0
11 2/		1.58	5.89	152	8.95	6.47	42.7	57.3	90	17.5
15		1.11	9.94	122	12.13	5.08	53.6	46.4	66	16.0
19		1.41	8.10	150	12.15	5.92	53.2	46.8	65	17.0
25		1.99	9.58	120	11.50	7.50	45.5	54.5	79	14.0
26 2/		1.81	5.74	160	9.18	6.22	44.9	55.1	58	17.5
31		1.29	9.60	141	13.54	6.30	55.9	44.1	86	21.5
Average	7	1.43	7.50	142	10.44	6.09	45.3	54.7	77	17.1
6		1.15	6.56	120	7.87	4.98	38.0	62.0	83	18.5
10		1.43	5.42	162	8.78	6.15	34.4	65.6	101	20.5
14 2/		1.63	8.08	166	13.41	6.49	61.2	38.8	114	18.0
18		0.92	11.21	123	13.79	5.62	56.8	43.2	78	16.3
20		1.58	7.13	157	11.19	5.30	55.6	44.4	55	19.0
27		1.25	9.23	130	12.00	6.44	42.6	57.4	73	17.0
30 2/		1.85	5.71	150	8.56	6.09	39.7	60.3	50	19.5
32		1.48	10.07	134	13.49	6.31	56.4	43.6	59	18.0
Average	10.4	1.41	7.93	143	11.14	5.92	48.1	51.9	77	18.4

1/ Corrected (a) for cane wt. loss in field
(b) to 1.0 lbs. susp. Field Soil per ton cane in dilute juice.

2/ Burned cane.

TABLE III.
1955 DELAYED MILLING AND PROCESSING EXPERIMENTS
SUGAR RECOVERY FROM CANE

Run No.	Days in Field	Cane Wt. Lbs./Ton Original	Sucrose % of Cane	Macer. %	Normal Juice Brix	Normal Juice % Sucrose	Normal and dilute Juice Purity	Extract. % of Suc. in Cane	Recoverable 96° Sug. % of Cane	Recoverable 96° Sug. Lbs./Ton orig. cane
1			10.59	21.6	16.43	12.03	73.2	88.25	9.31	186.2
4			7.22	28.5	13.43	8.54	63.6	81.89	4.77	95.4
8 1/			9.00	17.1	15.49	10.67	68.9	87.62	6.72	134.4
12			8.71	22.6	14.55	9.73	66.9	85.80	6.18	123.6
16			10.96	24.5	16.85	12.18	72.3	86.64	8.37	167.4
21			10.50	27.9	15.97	11.20	70.1	87.71	7.94	158.8
23 1/			10.00	25.1	15.54	10.86	69.9	87.66	7.56	151.2
28			10.54	20.7	17.14	11.71	68.3	86.24	7.71	154.2
Average 2		2000	9.69	23.5	15.68	10.85	69.2	86.48	7.32	146.4
2			9.77	23.9	16.87	12.03	71.3	85.84	7.33	146.6
5			7.21	15.3	13.57	8.56	63.1	82.00	4.72	94.4
9 1/			9.16	21.2	15.50	10.64	68.7	87.18	6.81	136.2
13			8.31	24.0	14.35	9.44	65.8	84.88	5.81	116.2
17			10.64	27.2	17.06	12.33	72.3	85.92	8.07	161.4
22			8.70	29.4	14.61	9.73	66.6	88.33	6.36	127.2
24 1/			10.08	24.3	15.59	10.60	68.0	87.90	7.49	149.8
29			9.70	17.8	14.64	9.98	68.2	86.65	7.12	142.4
Average 3		2000	9.20	22.9	15.27	10.39	68.0	86.09	6.71	134.3

TABLE III.
1955 DELAYED MILLING AND PROCESSING EXPERIMENTS
SUGAR RECOVERY FROM CANE

Run No.	Days in Field	Cane Wt. Lbs./Ton Original	Sucrose % of Cane	Macer. %	Normal Juice Brix	Normal Juice % Sucrose	Normal and dilute Juice Purity	Sucrose Extract % of Suc. in cane	Recoverable 96° Sug. % of Cane	Recoverable 96° Sug. Lbs/Ton orig. cane
3		1747	9.73	36.8	17.38	11.00	63.3	87.39	6.80	118.8
7		1760	6.70	17.8	14.10	7.87	55.8	84.90	4.05	71.3
11 1/		1953	9.31	19.2	15.77	10.35	65.6	89.86	6.35	124.0
15		1827	7.05	26.6	13.52	7.65	56.6	81.49	4.15	75.8
19		1733	11.77	25.1	18.84	13.51	71.7	87.21	9.00	156.0
25		1947	10.46	26.6	14.94	10.52	70.4	88.43	8.01	156.0
26 1/		1907	9.13	26.3	14.43	9.78	67.8	88.27	6.80	129.7
31		1867	9.99	19.1	15.96	11.52	72.2	86.70	7.63	142.4
Average	7	1843	9.27	24.7	15.62	10.22	65.4	86.78	6.60	121.8
6		1773	8.82	20.3	16.94	10.20	60.2	85.81	5.80	102.8
10		1707	8.52	26.3	14.46	7.95	55.0	80.76	4.82	82.3
14 1/		1933	9.52	20.6	16.88	10.85	64.3	86.84	6.70	129.5
18		1737	8.16	27.9	15.75	9.62	61.1	83.08	5.26	91.4
20		1707	10.40	25.1	18.86	12.64	67.0	89.03	7.75	132.3
27		1733	8.83	21.3	14.81	9.72	65.6	86.56	6.29	109.0
30 1/		1893	8.87	16.5	15.18	10.40	68.5	84.39	6.36	120.4
32		1840	9.78	22.0	15.35	10.59	69.0	86.30	7.21	132.7
Average	10.4	1790	9.11	22.5	16.03	10.23	63.8	85.35	6.27	112.6

1/ Burned Cane.

Table IV.

1955
PRICE DETERMINATION FOR 100 TONS OF SUGARCANE

	2 Days Old	3 Days Old	7 Days Old	11 Days Old
Price of sugar per pound	$0.060	$0.060	$0.060	$0.060
Price of molasses per gallon	.100	.100	.100	.100
Conversion of net sugarcane to standard sugarcane				
Sugarcane				
Sucrose in Normal Juice	10.85	10.41	10.22	10.23
Purity of Normal Juice	69.2	68.0	65.4	63.84
Sucrose Factor	.870	.778	.744	.746
Purity Factor	.960	.951	.913	.885
Conversion Factor	.8352	.7399	.6793	.6602
Price of Standard Sugarcane per ton	$6.36	$6.36	$6.36	$6.36
Sucrose Value per ton/cane	5.312	4.706	4.320	4.199
Molasses Value per ton/cane	.144	.144	.144	.144
	$5.456	4.850	$4.464	$4.342
Weight of cane	2000 lb.	2000 lb.	1843 lb.	1791 lb.
Value of 100 tons sugarcane	$545.60	$485.00	$411.36	$389.01

Processing Characteristics

of

Three Recently Released Sugarcanes

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Experiments were completed in 1955 for the sixth consecutive season during which the processing characteristics of new sugarcanes have been determined by milling and clarification on a pilot plant scale, in cooperation with the American Sugar Cane League and Louisiana State University. It has been decided with concurrence of the Industrial Committee, that the League would furnish adequate quantities of the two most promising new varieties, C.P. 48-103 and C.P. 47-193 and of the variety N.Co. 310 released in 1954, and of C.P. 44-101 which is the standard for comparison. Both of the new varieties were released at the Contact Committee meeting in June 1955, so that the results provide valuable information of the processing characteristics of the three newest canes available to the industry. Mr. Lloyd Lauden arranged for production of all of these varieties in the amounts of both plant and stubble cane required at St. Gabriel Plantation, where cultivation and harvesting was ably supervised by Capt. L. E. Chambers. Results of experiments on milling these samples will be reported separately by Prof. A. G. Keller, who supervised milling research under a contract from the Southern Utilization Research Branch. Clarification data reported here were obtained on juices produced in the milling experiments.

Reasonably favorable weather for harvesting prevailed throughout the season, with moderate rainfall and only two brief periods during which temperatures dropped below freezing, as shown in Figure 1. None of the cane used had been frozen. It was originally planned to burn the cane in heap rows as in commercial harvesting and grind within 48-72 hours after cutting. Location of heap rows of cut cane near the standing cane prevented burning of all but four samples, and the average trash content was about twice that of the hand-cleaned cane samples used in previous seasons.

1/ One of the laboratories of the Southern Utilization Research Branch, Agricultural Reseach Service, U.S. Department of Agriculture.

The pilot plant equipment and procedures for determining clarification characteristics have been described in a series of previous reports, the latest of which appeared in the Sugar Journal for November 1955 (1). A new clarifier was installed with a larger volume to provide for a retention time of 78 minutes. Rakes were installed comparable to those on one tray of a standard clarifier to obtain denser mud. Operating at 50 gallons per hour, the juice rose at a linear rate of about 2 feet per hour, comparable to that in commercial clarifiers of the latest design.

Purities

The purities, and increases in purity by clarification, shown in Figure 2 for plant and stubble canes of each variety are averages of duplicate test determinations given in Table I. Dilute juice purities were less variable among the different samples but were appreciably lower than those determined in previous seasons. The average for all experiments was only 68.6, compared with an average purity of 75 for the 1954 season. Unusually low purities throughout the grinding season were experienced at nearly all the factories during 1955. As in all previous seasons, the response to clarification gave inconsistent rises in purity that cannot be correlated with other characteristics of the juices tested. Relatively high purities of both stubble and plant cane juices of C.P. 48-103 reflect the superior sugar content per ton found in the agronomic test of this variety. All of the juices were limed to give a pH between 6.6 and 6.7 after clarification. The stubble cane juices were limed to a slightly higher pH, about 7.35, to produce the same final pH as in plant cane juices limed to 7.3 later in the season. The average final pH was 6.63 for all juices after clarification.

Mud Quantities

Weight of mud per ton of cane, that is, the total slurry discharged from the clarifier, is the most important quantity that can be measured and duplicated with reasonable accuracy in continuous clarification on a pilot plant scale. The individual determinations given in Table II are shown as averages for the stubble and plant cane juices of each variety in the bar graph, Figure 3. The large quantity of clarifier discharge that must be handled in processing C.P. 47-193 was evident again, as it has been in all experiments with this cane. The superiority of C.P. 48-103 was shown by the smaller quantities of mud produced from stubble cane juices of this variety early in the season, but plant cane juices of both C.P. 48-103 and N.Co. 310 produced equal quantities of mud during the latter part of the season. In the line with previous

results, C.P. 47-193 gives about 15% more mud from plant cane and 33% more mud from stubble cane than C.P. 48-103. This is true in spite of the higher density of the clarifier discharge of C.P. 47-193, shown by the actual and corrected weights of dry solids given in Table II. This increased quantity of mud would require clarification of C.P. 47-193 at about one-third lower capacity than C.P. 48-103, on the average, for plant and stubble cane. N.Co. 310 was equal to standard variety C.P. 44-101 in this respect, while C.P. 48-103 was slightly better than standard in both plant and stubble experiments during the past season.

Lime Consumption

The average results in Figure 4 show that more lime is used for plant cane juices than for the stubble cane juices of each variety to obtain the same clarified juice pH. The weight of lime required parallels in general the quantity of precipitate formed in clarification, being much larger for C.P. 47-193 than for C.P. 48-103. Exceptions are the relatively small amounts of lime used on N.Co. 310 juice to produce quantities of mud about equal to those obtained from standard variety C.P. 44-101 and the large amount of lime consumed by plant cane juice of C.P. 48-103 that did not yield a large quantity of mud. Variations would be expected because of differences in composition of the impurities precipitated by lime, and variation of the amounts of field mud that must be handled with the precipitate formed by liming. The range of variation in lime requirement is twofold, from a little over 0.7 lb. to a maximum of more than 1.5 lb. per ton of cane.

Clarities

Average clarities calculated from individual determinations listed in Table I are shown in Figure 5, and are consistently lower than clarities obtained with the higher purity, more mature cane processed during 1954. Poorer clarities were obtained for all varieties in 1955 in spite of the fact that the quantities of clarification mud were higher in 1955 than in 1954 in each case. The better clarities obtained for C.P. 47-193 compensate somewhat for the larger quantities of mud that must be handled in clarifying this cane. The best clarity was obtained with stubble cane juice of C.P. 47-193, and C.P. 48-103 stubble juice also gave a higher clarity than the standard, while producing a smaller quantity of mud. The standard and C.P. 48-103 stubble canes had more trash than the samples of C.P. 47-193 that were cleaned by burning. Plant canes of the new varieties all gave lower clarities than the standard, but the C.P. 44-101 was cleaned by burning in this case. The importance of higher clarities in obtaining greater recoveries of sugar of better quality has not been determined,

but high clarity is undoubtedly desirable.

Summary of Results and Ratings

Clarification characteristics of the three new canes and the standard can be compared conveniently from the data assembled in Figure 7, showing mud quantities, clarities, purities, and the purity rises in clarification for the plant and stubble canes separately. Averages of the data for both plant and stubble cane each variety were used to compute the percentage ratings relative to standard C.P. 44-101 given in Figure 8. As in previous seasons, C.P. 48-103 produced the least mud, C.P. 47-193 was highest in clarity, and N.Co. 310 was intermediate in quantity of mud produced with lowest clarity.

Evaluation on Results for Four Seasons

Experiments have been made with cane of the three most recently released varieties and standard C.P. 44-101 for four consecutive seasons, and the results are summarized in Table III. In 1952 and 1953 the cane of the new varieties was grown at Southdown with the exception of one sample obtained from St. Gabriel, while the standard C.P. 44-101 was grown at San Francisco Plantation. During 1954 and 1955 all cane was grown at St. Gabriel. Conditions for growing and harvesting were above average to excellent during all four seasons. There were no damaging freezes or long periods of excessive rainfall in any of these years. The only abnormal condition experienced was the late maturity and the resultant low purities during 1955. Quality of the cane samples ranged from the poorest in 1955, with only 9--10% sucrose and purities below 70, to the excellent quality of the 1953 samples with 12-14.5% sucrose and purities of 80-85. The varieties used for the experiments have been exposed to the range of conditions that can be expected in all but abnormal seasons. Comparisons based upon the cumulative data obtained over this period provide a much better indication of what can be expected of these new varieties than is obtained from results during any one season.

Data for the plant and stubble cane samples have been averaged together in Table III and weighted averages are given for the total number of experiments on each variety during the four years. These are expressed as percentages of the values for standard C.P. 44-101 at the bottom of the table. The quality of all three new varieties is better than that of the standard, and the high rating of C.P. 48-103 in sucrose content, purity, and recoverable sugar for these experiments reflects the high sugar productivity that has been determined agronomically for this cane. In the 16 experiments with C.P. 48-103 during four years it has proven equal to the standard in clarity, while being the

most superior of the new varieties in the quantity of mud produced and capacity at which it can be clarified. A denser precipitate is obtained consistently from juices of this cane, averaging 32% higher than the density of mud from the standard cane, so that more solid impurities are removed in a smaller volume of precipitate in clarification.

Juices of N.Co. 310 rate better than standard in the quantity of mud produced and yield a denser precipitate than any of the juices tested on the average. This cane would be approximately equal to C.P. 48-103 in clarification if the treated juice clarities were at least equal to the standard, but its clarities averaged only 82% of C.P. 48-103, which equals the standard in clarity. The best characteristic of C.P. 47-193 is the clarity of the treated juices, averaging 11% better than standard C.P. 44-101; this is obtained at the expense of a much larger quantity of precipitate in clarification, in which respect its rating is only 84% of standard. Chemical analyses of the juices show that C.P. 47-193 has a higher average phosphate content, while N. Co. 310 is consistently high in wax and organic colloid impurities. C.P. 48-103 has the highest starch content of any of these canes.

Significance of Data

The reproducibility and significance of data obtained in this limited number of experiments with each of the canes has been calculated with the results shown in Table IV. Practical significance of the results is expressed best by the confidence limits at the 95% level, giving the range of values outside of which the mud volume or clarity would be expected to fall only once in twenty repetitions of the experiment with a given variety. The odds are 20 to 1 that an additional experiment with each variety would give values within the confidence limits shown. For example, there is only 1 chance in 20 that the largest quantity of mud obtained from C.P. 48-103 would be more than the minimum quantity that can be expected in an additional experiment with standard C.P. 44-101. These are very good odds that, year in and year out, C.P. 48-103 will be superior to the standard in this respect. The confidence limits for clarity show that C.P. 48-103 can be expected to equal the standard, with good odds that it would give better clarities as often as it would give poorer ones in clarification.

Literature Cited

(1) Guilbeau, W. F., Coll, E. E., and Martin, L. F. Processing Characteristics of Sugarcane Varieties Grown in 1954. The Sugar Jour. 18, 6, pp. 26-29 (1955)

Table I.
1955 VARIETY PROCESSING EXPERIMENTS
Clarification Conditions and Processing Results

Date Harvested	Cane Variety[1]		Run No.	Trash, % of Cane	Susp. Soil in Dil. Juice, lb./T. Cane	Dilute Juice pH	Limed Juice pH	Defecated Juice pH	Defecated Juice Clarity[2]	Apparent Purities of Juice Dilute	Apparent Purities of Juice Defecated
10/24	C.P. 44-101	S	4	6.0	1.38	5.75	7.35	6.60	34	63.6	65.7
10/24	"	S	5	5.0	1.50	5.65	7.50	6.65	40	63.1	64.6
11/28	"	P[3]	23	3.0	1.65	5.75	7.30	6.65	43	69.9	71.5
11/28	"	P[3]	24	3.3	2.54	5.70	7.30	6.65	44	68.0	71.4
	Average			4.3	1.77	5.71	7.36	6.64	40	66.2	68.3
10/31	C.P. 47-193	S[3]	8	1.0	1.10	5.40	7.30	6.60	53	68.9	70.4
10/31	"	S[3]	9	1.5	1.31	5.30	7.40	6.65	53	68.7	70.9
12/5	"	P	28	8.7	9.31	5.65	7.25	6.70	38	68.3	72.6
12/5	"	P	29	8.7	8.46	5.60	7.20	6.65	37	68.2	72.7
	Average			5.0	5.04	5.49	7.29	6.65	45	68.5	71.6
10/17	C.P. 48-103	S	1	4.0	1.22	5.70	7.30	6.60	45	73.2	75.3
10/17	"	S	2	1.5	1.42	5.65	7.30	6.60	41	71.3	73.1
11/14	"	P	16	10.0	5.57	5.50	7.30	6.65	35	72.3	75.2
11/14	"	P	17	8.0	4.39	5.60	7.25	6.65	32	72.3	75.1
	Average			5.9	3.15	5.61	7.29	6.62	38	72.3	74.7
11/7	N.Co. 310	S	12	3.0	5.59	5.65	7.35	6.65	39	66.9	71.6
11/7	"	S	13	11.0	6.74	5.65	7.40	6.60	35	65.8	71.1
11/26	"	P	21	8.0	4.64	5.65	7.35	6.60	29	70.1	73.1
11/26	"	P	22	6.0	4.37	5.75	7.35	6.65	21	66.6	69.9
	Average			7.0	5.34	5.68	7.36	6.62	31	67.4	71.4

1 S - 1st year stubble cane
P - Plant cane

2 Adjusted to 14.0 Brix as standard

3 Burned cane

Table II.
1955 VARIETY PROCESSING EXPERIMENTS
Lime Requirements and Mud Evaluations

Cane Variety[1]	Run No.	Lime Required lb./T. Cane	Dry Solids, % of Mud Weight	Mud Weight, lb./T. Cane Wet	Dry Solids Actual	Dry Solids Corrected[2]	Dry Solids Analyses, Weight % Mineral	Organic	Filtration, gal./100 sq.ft./hr.	Settling, % Mud Vol. in 60 min.
C.P. 44-101 S	4	0.97	6.45	116	7.48	6.10	35.2	64.8	98	16.0
" S	5	1.14	5.58	134	7.48	5.98	36.3	63.7	87	20.0
" P[3]	23	1.42	5.29	144	7.62	5.97	37.3	62.7	75	14.0
" P[3]	24	1.46	6.38	135	8.61	6.07	44.3	55.7	83	16.5
Average		1.25	5.93	132	7.80	6.03	38.3	61.7	86	16.6
C.P. 47-193 S[3]	8	1.32	4.71	142	6.69	5.59	36.1	63.9	125	16.5
" S[3]	9	1.39	5.13	159	8.16	6.85	34.0	66.0	143	16.5
" P	28	1.52	11.51	147	16.92	7.61	61.7	38.3	70	18.1
" P	29	1.53	10.79	151	16.29	7.83	58.8	41.2	70	21.0
Average		1.44	8.04	150	12.02	6.97	47.6	52.4	102	18.0
C.P. 48-103 S	1	0.70	5.04	120	6.05	4.83	31.4	68.6	103	12.0
" S	2	0.78	5.60	106	5.94	4.52	33.4	66.6	98	19.0
" P	16	1.55	9.01	134	12.07	6.50	53.1	46.9	41	17.5
" P	17	1.38	8.73	121	10.56	6.17	47.9	52.1	54	17.5
Average		1.10	7.10	120	8.66	5.50	41.4	58.6	74	16.5
N.Co. 310 S	12	0.79	9.77	130	12.70	7.11	52.3	47.7	75	14.5
" S	13	0.89	11.49	122	14.02	7.28	56.0	44.0	71	17.0
" P	21	1.18	7.64	154	11.77	7.13	44.1	55.9	62	17.5
" "	22	0.95	9.56	102	9.75	5.38	46.5	53.5	129	14.0
Average		0.95	9.62	127	12.06	6.72	49.7	50.3	84	15.8

[1] S - 1st year stubble cane
P - Plant cane

[2] Adjusted to 1.0 lb. suspended field soil per ton cane in dilute raw juice.

[3] Burned cane

Table III.
YEARLY SUMMARY OF VARIETY MILLING AND PROCESSING CHARACTERISTICS
(Variety C.P. 44-101 as the Standard)

Year & Field	Cane Variety	No. of Tests	Dilute Juice Purity	Defecated Juice Purity	Defecated Juice Clarity	Mud Produced, lb./T. Cane	Dry Solids, % of Mud Weight	Sucrose, (Pol) % Cane	Sucr. Extr., % Sucrose in Cane	T.A. 96° Sugar, lb./T. Cane
1952 SF[1]	C.P. 44-101	5	76.2	78.6	39	140	6.19	11.96	90.63	180.6
1953 SF	"	4	80.0	81.5	44	170	4.91	12.16	89.18	181.9
1954 SG[2]	"	4	69.8	73.9	54	116	6.60	9.14	90.14	143.3
1955	"	4	66.2	68.3	40	132	5.93	8.63	84.86	114.7
Weighted Average		17	73.2	75.8	44	140	5.91	10.56	88.82	156.6
1952 Sd.[3]	C.P. 47-193	4	76.4	78.4	42	154	6.64	11.58	89.00	169.8
1953 Sd.	"	4	82.8	84.5	52	231	4.71	12.75	89.18	195.6
1954 SG	"	4	76.7	78.0	56	134	6.86	11.03	89.10	182.8
1955 SG	"	4	68.5	71.6	45	150	8.04	9.60	86.92	130.2
Weighted Average		16	76.1	78.1	49	167	6.56	11.24	88.55	169.6
1952 Sd.	C.P. 48-103	4	81.5	82.6	36	151	9.08	13.78	87.87	207.5
1953 Sd.	"	4	84.7	87.2	42	128	6.15	14.46	86.99	220.4
1954 SG	"	4	79.7	81.1	60	107	8.92	12.88	90.52	218.4
1955 SG	"	4	72.3	74.7	38	120	7.10	10.49	86.66	143.2
Weighted Average		16	79.6	81.4	44	126	7.81	12.90	88.01	197.4
1952 Sd.	N.Co. 310	4	75.4	77.2	33	122	8.06	11.70	89.69	174.6
1953 Sd., SG	"	4	83.9	86.4	39	152	10.68	13.84	89.12	214.6
1954 SG	"	4	78.7	80.4	43	121	9.28	11.30	90.26	189.3
1955 SG	"	4	67.4	71.4	31	127	9.62	9.06	86.68	120.6
Weighted Average		16	76.4	78.8	36	130	9.41	11.48	88.94	174.8
Comparative Ratings, % of Standard C.P. 44-101 (100%)										
	C.P. 47-193		104	103	111	84*	110	106	100	108
	C.P. 48-103		109	107	100	111*	132	122	99	126
	N.Co. 310		104	104	82	108*	159	109	100	112

[1] San Francisco Plantation
[2] St. Gabriel Plantation
[3] Southdown Plantation
* Reciprocal percentage shows high numbers as desirable.

Table IV.

MUD DISCHARGE FROM CLARIFIER
Average for 1950-55

Cane Variety	Number of Tests	Mud lb./T. Cane	Standard Deviation lb./T. Cane	95% Confidence Limits
C.P. 44-101	20	143	33	127-159
C.P. 47-193	16	169	44	145-193
C.P. 48-103	15	117	16	108-126
N.Co. 310	16	130	24	117-143

Table V.

CLARITY OF DEFECATED JUICE
Average for 1950-55 Seasons

Cane Variety	Number of Tests	% Light Transmission	Standard Deviation	95% Confidence Limits
C.P. 44-101	20	44	7.6	40-48
C.P. 47-193	16	49	8.0	45-53
C.P. 48-103	15	45	12.5	38-52
N.Co. 310	16	36	7.9	32-40

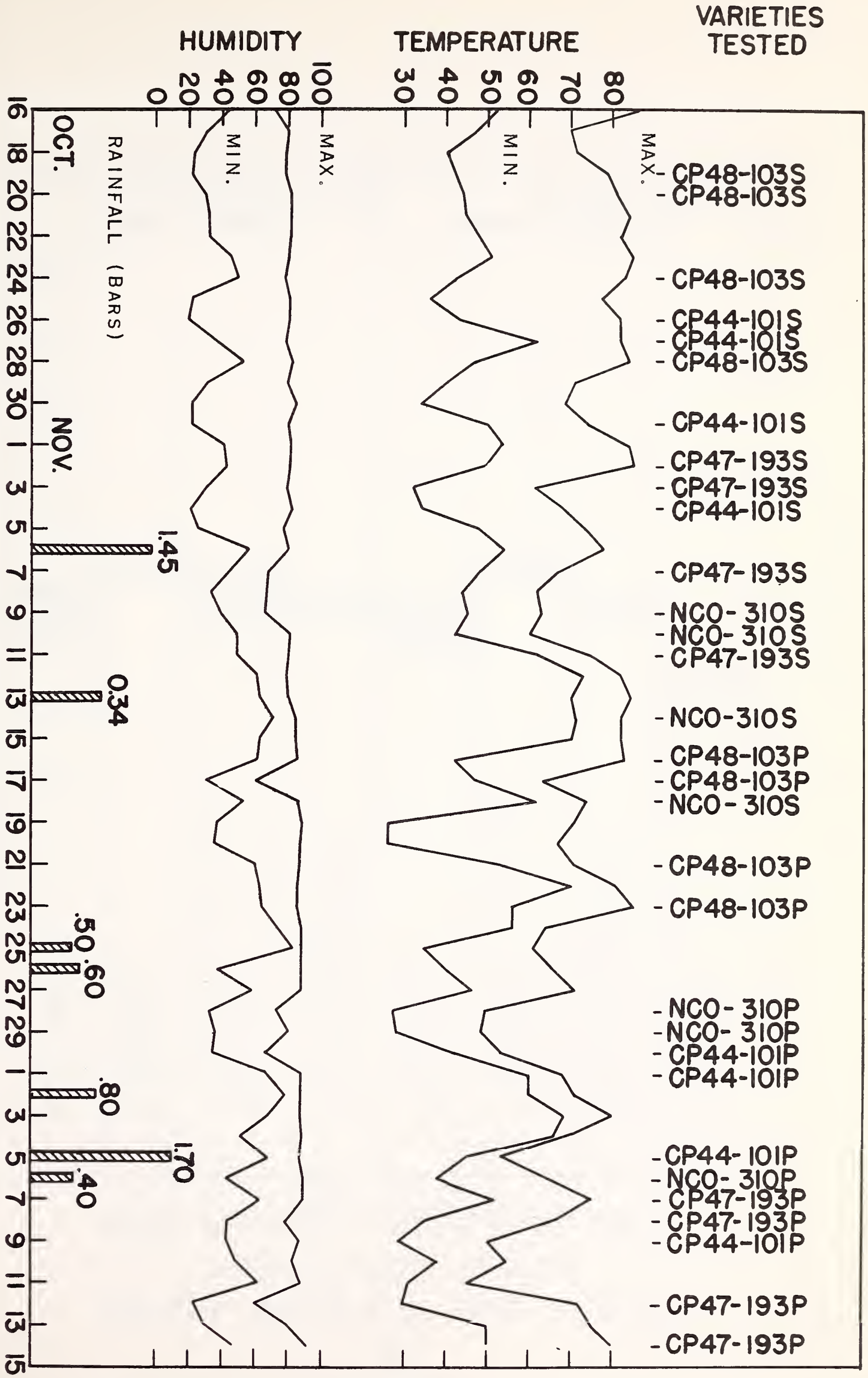

FIG. 1-WEATHER CONDITIONS DURING 1955 GRINDING SEASON

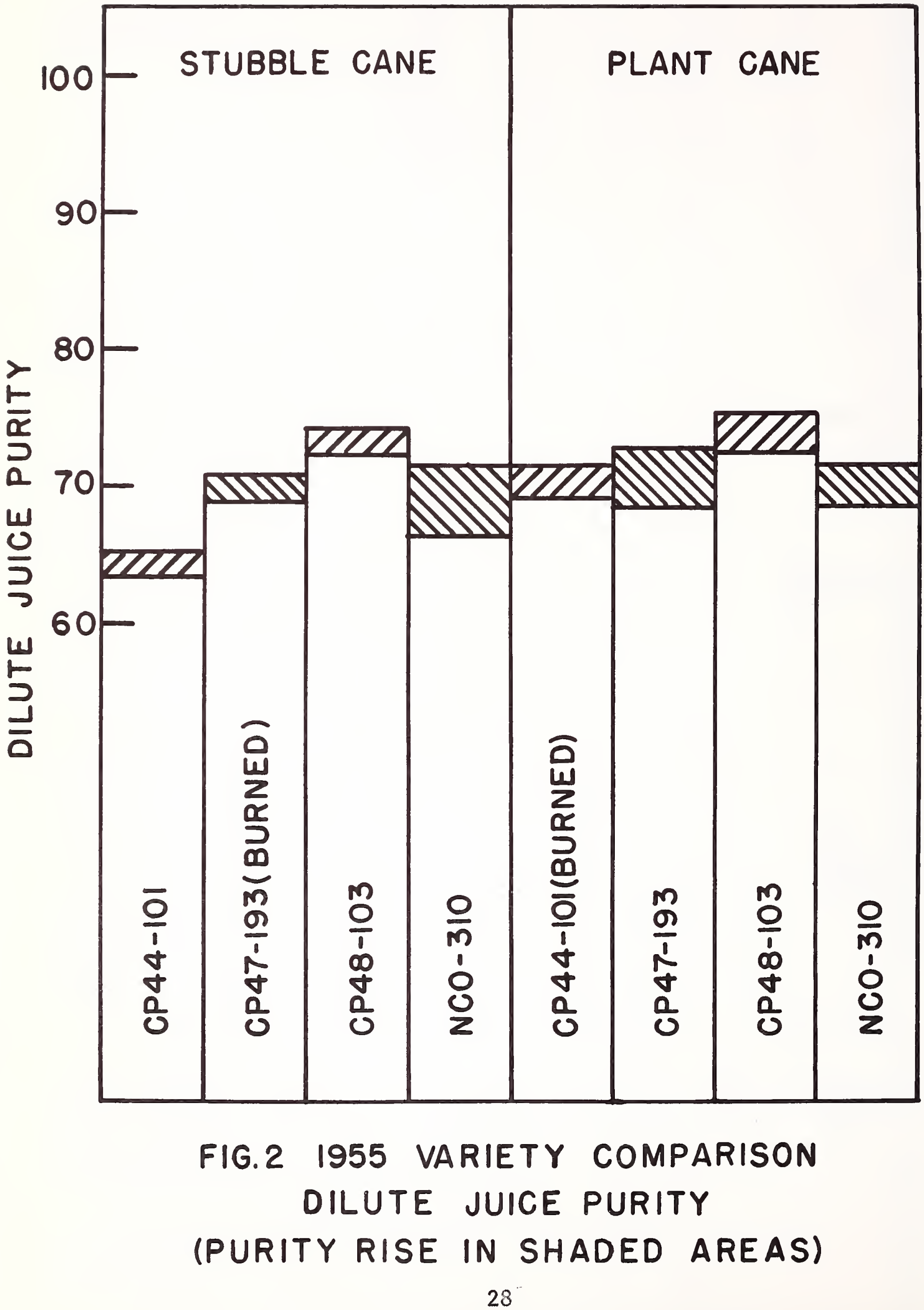

FIG. 2 1955 VARIETY COMPARISON
DILUTE JUICE PURITY
(PURITY RISE IN SHADED AREAS)

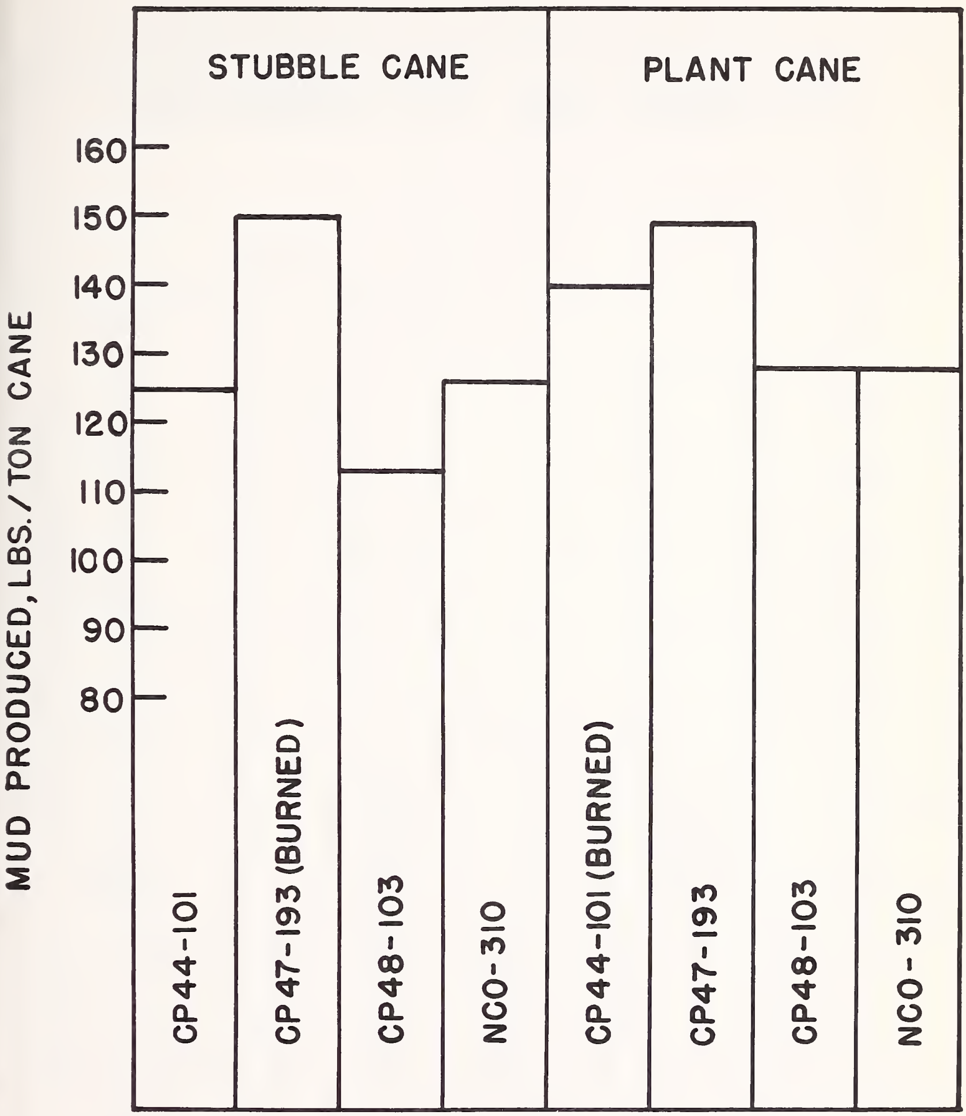

FIG. 3 1955 VARIETY COMPARISON
MUD PRODUCTION

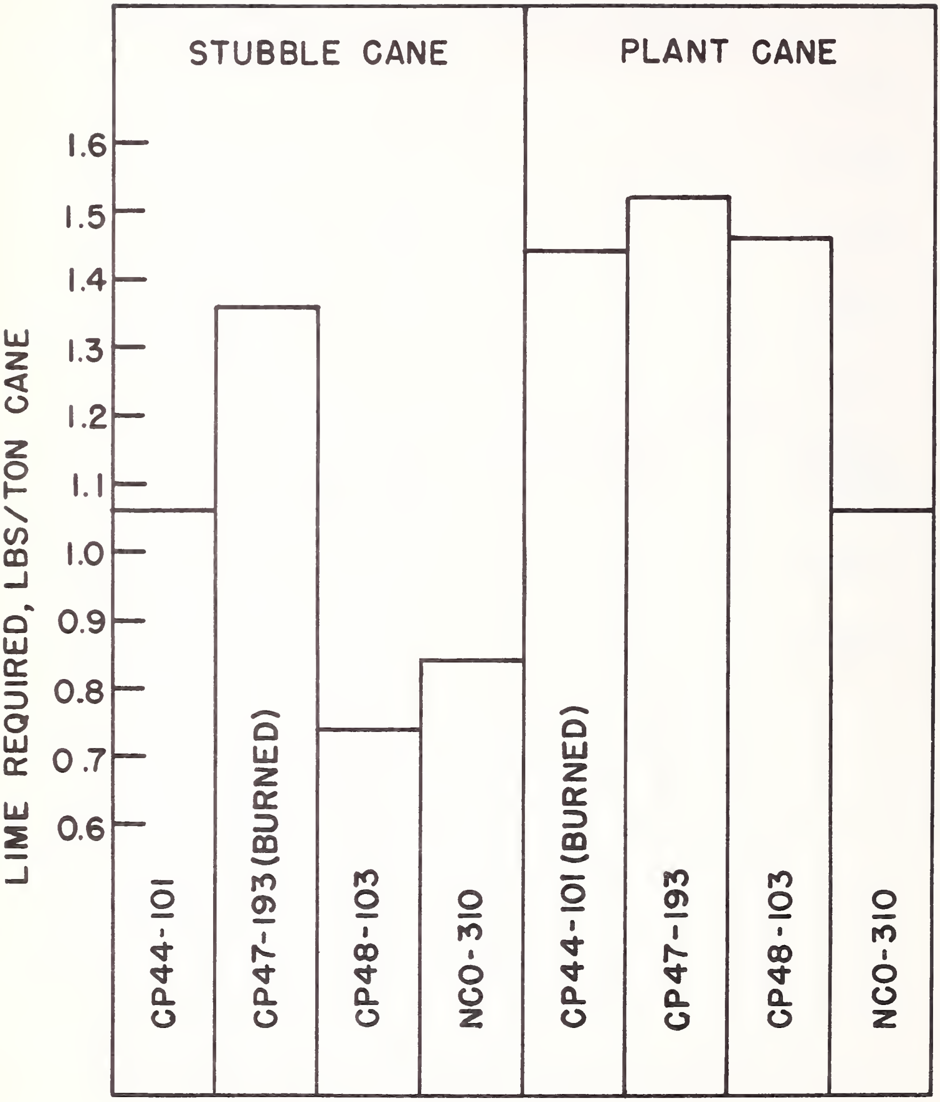

FIG. 4 1955 VARIETY COMPARISON
LIME REQUIREMENT

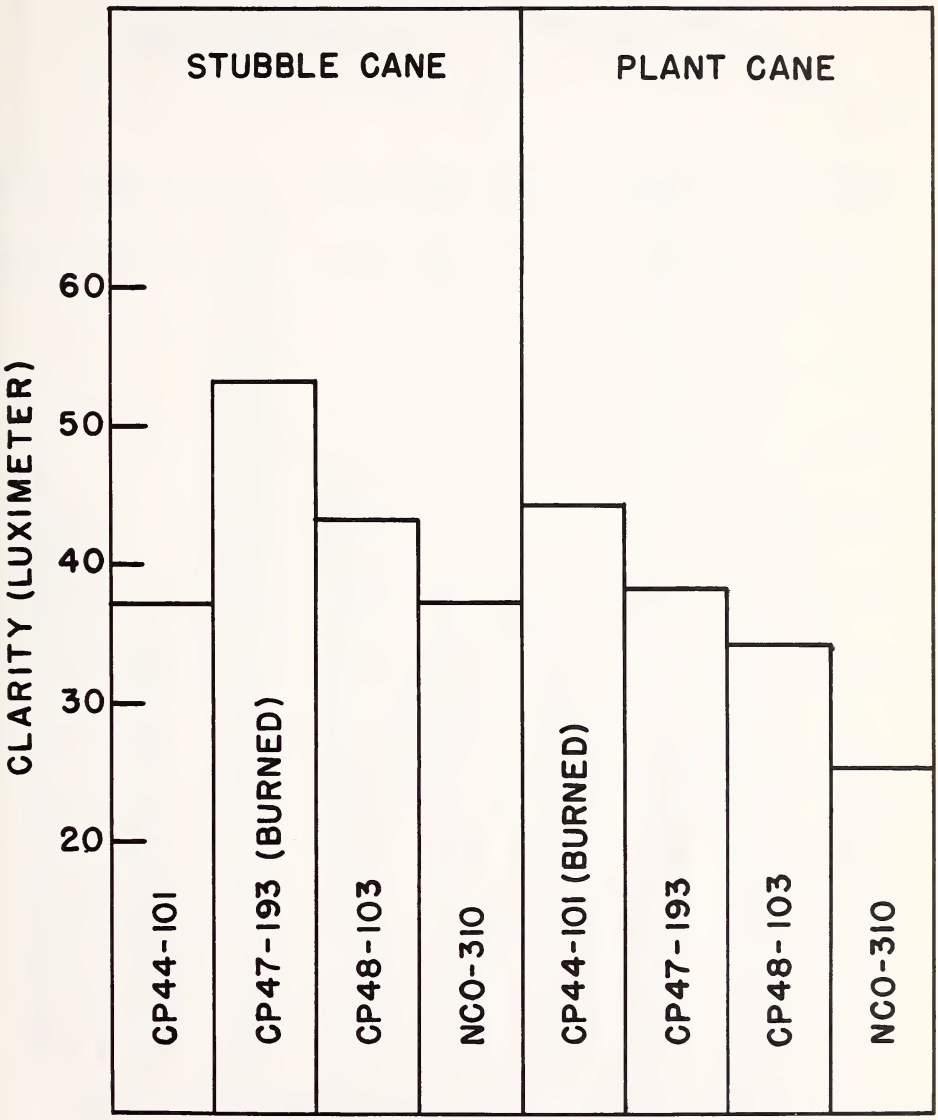

FIG. 5 1955 VARIETY COMPARISON
DEFECATED JUICE CLARITY

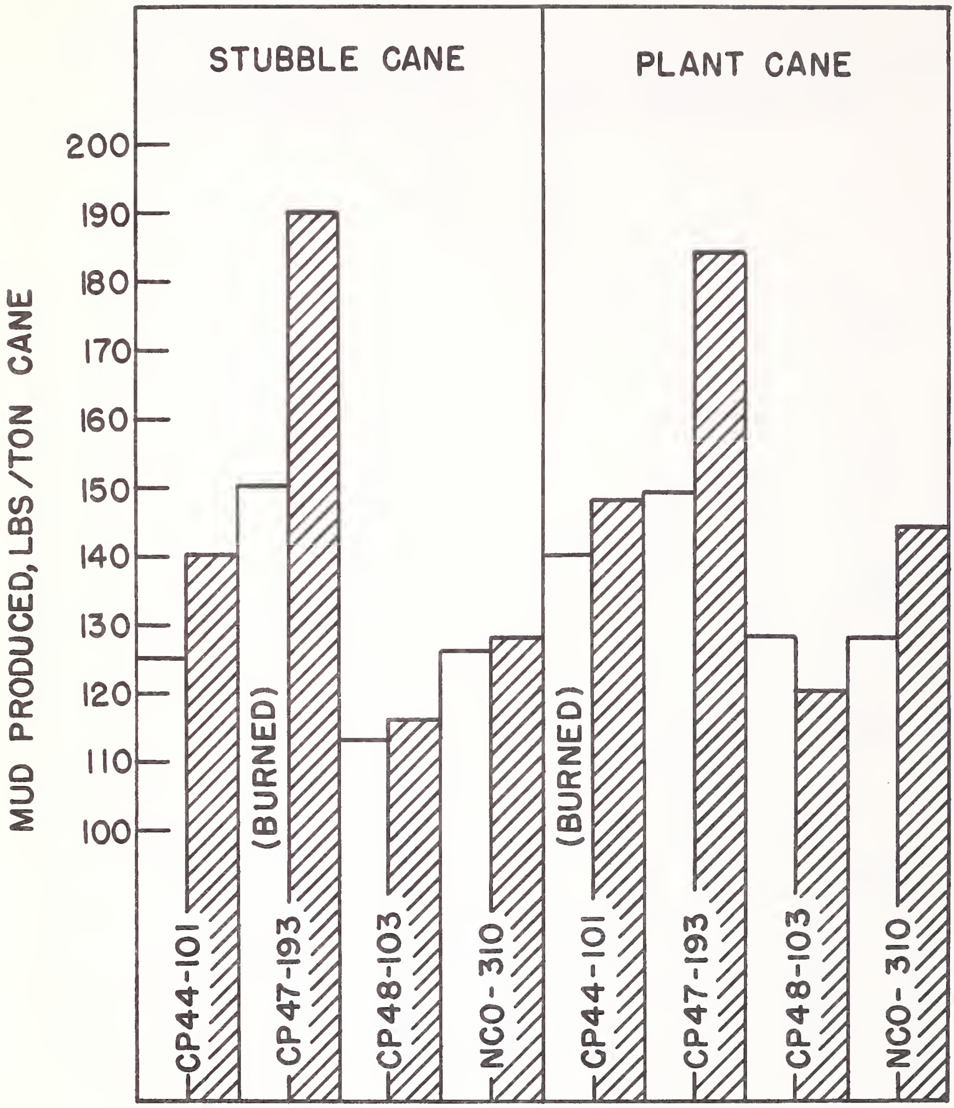

FIG. 6 1955 SEASONAL COMPARISON OF MUD PRODUCTION
(AVERAGE OF 1953-54 TEST SHADED)

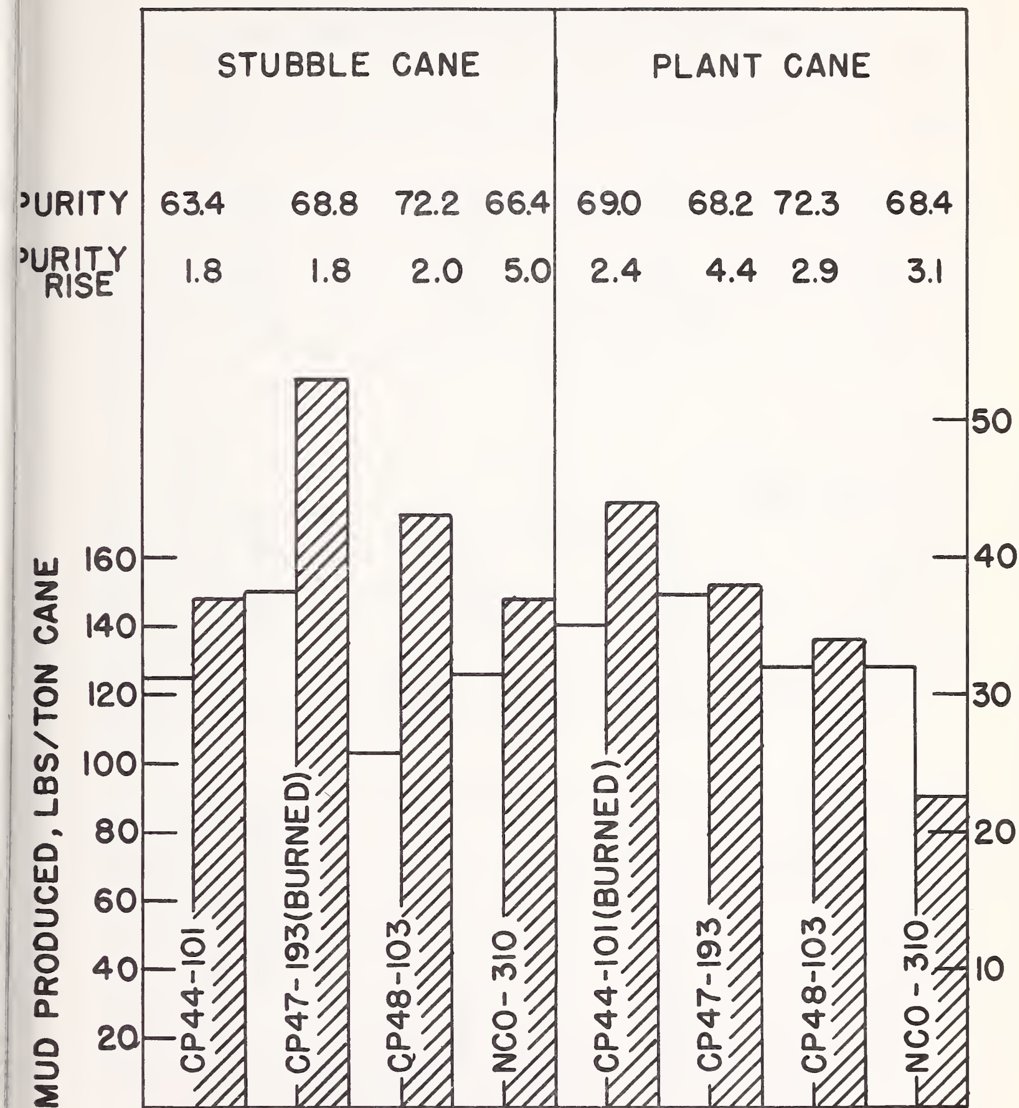

FIG. 7 1955 SUMMARY OF VARIETY COMPARISONS ON PROCESSING RESULTS

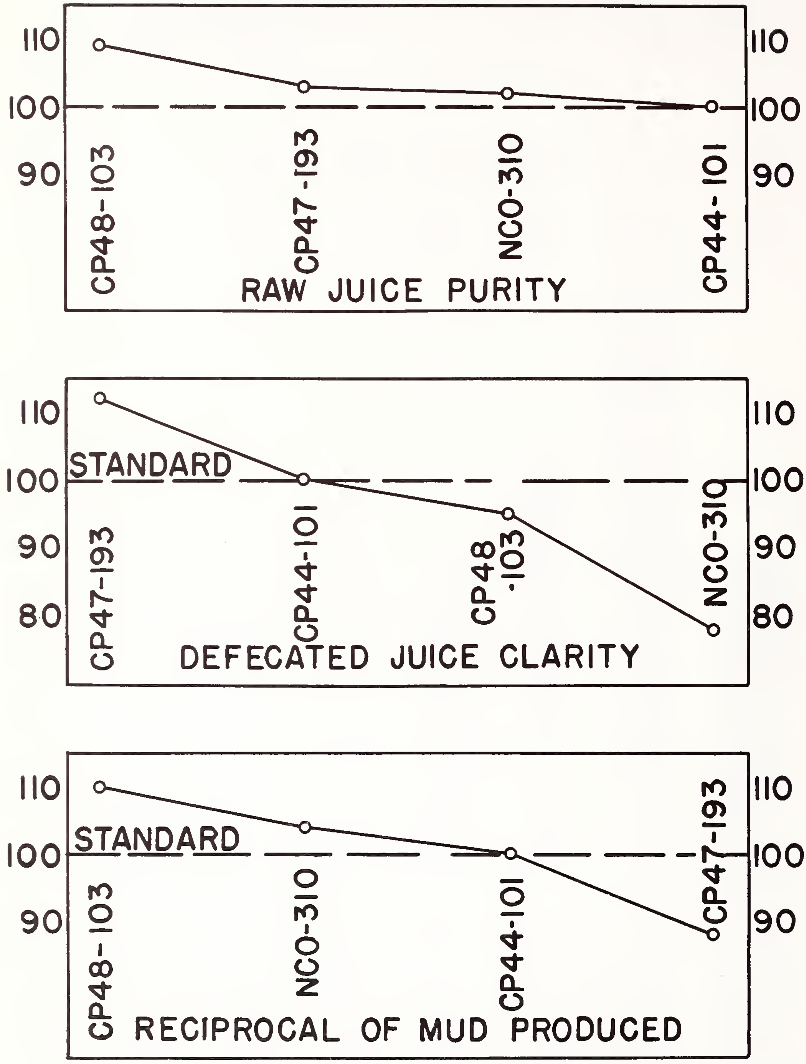

FIG.8 1955 VARIETY COMPARISONS
(C.P.44-101 AS STANDARD)

ECONOMICAL BAGASSE SEPARATION

Arthur G. Keller
Louisiana State University

Bagasse, the fibrous residue from the milling of sugar cane, has attracted the attention of inventors and promoters for more than 100 years as a possible source of raw material for the production of pulp for use either in wall board or paper. West (1) has traced the history of bagasse as a material for paper production back as far as 1856. In another review (2) he lists U.S. Patents dating back as early as 1863 and covering the use of bagasse as a raw material for paper production.

The large annual production of bagasse, estimated to exceed 50,000,000 tons, plus the fact that the material is concentrated at the sugar factories which are relatively few in number would make it appear that this should be a cheap, renewable and excellent material for any product requiring cellulose as its principal constituent. Despite more than 100 years of effort, the use of bagasse other than as fuel for the sugar factories has not achieved any considerable industrial importance. The major exception to this, has been its use, in Louisiana, by the Celotex Corporation for the production of wall board. This enterprise is approximately 30 years old.

The successful commercial exploitation of bagasse as a raw material for the production of wall board in Louisiana and elsewhere appears to be the result of two principal factors. First, advantage is taken of an inherent property of bagasse to produce a quality product which cannot be easily duplicated by the use of any other raw material. Second, an extensive sales promotion program is practiced. Even with the vast market available in the United States, this use only accounts for about 25% of the bagasse production of Louisiana. Smaller quantities are utilized in the production of animal litter and agricultural mulch. Recently one company has gone into the commercial production of paper in Louisiana using sugar cane bagasse.

The field of use for bagasse which has received the greatest amount of investigation over the past century is that of pulp production for paper manufacture. A study of the more serious experimental work combined with an investigation of present day successful commercial operations

indicate the following items must be considered by workers in the field (3,4).

1. Except for use in wall board, corrugating medium and similar products, it is essential to separate the pith from the bagasse to produce a fiber suitable for conversion into a high grade product.
2. Pith free fiber is an excellent raw material for the production of high grade pulps and papers.
3. Pith free fiber can be converted into pulp by any of the ordinary pulping processes or well known modifications.
4. The choice of the various processes available is a matter of economics, depending on the specific location of the plant.

Production of a clean high grade pulp of uniform quality from bagasse is obviously difficult but not impossible of achievement. The irregular nature of the raw material makes a preliminary screening and cleaning operation advisable to remove soil, some pith and solubles. Sizing also aids in the subsequent pulping operations. These operations are made difficult by the fact that bagasse, as produced, is damp and will quickly blind most screens. Wet screens have also proven difficult and unsatisfactory. Chemical cleaning and or separation methods are rendered difficult by the chemical similarity of the materials to be separated. Several mechanical cleaning or separating methods have been advocated and some of these appear to offer considerable promise.

Mechanical removal of pith and extraneous material from bagasse fiber to be satisfactory must be low in cost, efficient, and must not involve appreciable loss of fiber in the separated pith. The separation can be accomplished manually by rubbing the bagasse together in the hands thus loosening the soft pith from the tougher fibers. Use of this idea has been advocated by inventors who have proposed rod mills, and cage mills in various designs and arrangements to bring about the necessary rubbing action. Power consumption in most of these schemes has been excessive and fiber losses with the pith relatively high. Wet separation processes in which the bagasse, while treated, is immersed in a body of water have been more complete, but generally present the problem of relatively high power costs plus the problem of handling the excessively wet fiber.

The work reported in this paper resulted in the development of a modified swing hammer mill which overcomes most, if not all, of the objections to previous methods. The design of the mill, and the process involved in its use in the separation of pith from bagasse are covered by U.S. (5) and foreign patents and patent applications. All patents on the equipment and process are the property of the Board of Supervisors of the Louisiana State University and Agricultural and Mechanical College.

The separator unit is a modified swing hammer mill. The housing for the rotor has been modified so that bagasse may be fed into the mill at one end of the housing and can travel the length of the rotor across the top of the revolving hammers. Passage of the material across the rotor is assisted by having some of the hammers twisted to give a screw effect. The housing instead of ending at the last hammer circle on the rotor is extended for some distance to provide space through which the depithed fiber can be discharged from the machine. Pith which is knocked free from the bagasse by the action of the hammers falls to the bottom half of the hammer circle which is closed by a perforated metal plate. The action of the hammers is such as to keep the surface of this perforated plate free of material and to assist in driving the separated pith through the openings. The size opening used can be varied to suit the application but is usually 1/8" in diameter. Below the housing, separate chutes are provided for removal of separated pith and depithed fiber.

The present separator design has gone through three scale ups from the original conception. The units presently in service in the pilot plant located in the Audubon Sugar Factory at Louisiana State University have had a total of more than 1000 hours of actual operating time. Plate 1 shows a general view of one of the three mills in the plant installation. It will be noted that this mill is provided with a screw feeder which introduces the mill run bagasse into the end of the hammer casing Plate 2 is a view of the same unit with the cover removed to show the separation in the casing and the screen arrangement for removal of depithed fiber and pith, respectively.

The mills are designed so that they can be operated either as a dry separation unit or as a wet separation unit. Generally, for preliminary separation which might be done at the sugar factory, a dry separation should be made. Should a further separation of pith from the fiber product be desired, this might be done at the point where pulp is produced. In such cases, it would be desirable and necessary to introduce water through the pipes shown in plate 1 to wash the separated pith from the fiber.

Where the pulping operation is conducted on the same site as the cane grinding operation, it is possible, with the separator unit, to remove the major portion of the pith and dirt from the bagasse with a dry operation. This material could be returned to the raw sugar factory as fuel or used for such other purposes as might be desired. The fiber product from this operation could then be further separated employing water in the process and sugar values thus recovered from the bagasse. The quantity of water involved is such that it could be returned to process for use in

maceration of the stalks thereby permitting an increase in the overall sucrose extraction of the milling unit.(6).

The mills presently in use have a hammer tip circle diameter of 17 1/2" and a working screen length of 21". The capacity of this unit is 3000 pounds of mill run bagasse per hour. At this capacity and using a 3/16" perforated screen about 20 to 25% by weight of the bagasse fed will be removed as dry pith. It should be noted that the material removed is not only pure pith or parenchyma, but also includes dirt, some short fiber particles, and pith and fiber bundles. The fiber product is not entirely pith free but is substantially so and is very much improved in so far as the removal of dirt is concerned. Plates 3,4 and 5 illustrate the appearance of the bagasse feed, the fiber product and the pith fraction, respectively. Power requirements for the depithing operation utilizing a single mill and removing, approximately 20% by weight of the bagasse fed as pith, are 4 kilowatt hours per ton of "mill run" bagasse fed. Rotor speed on the unit is 850 rpm.

Operating conditions in the separator unit are not critical. The most satisfactory work is obtained when the machine is operated under full load conditions. As with any requipment of this type, a steady, uniform feed is desirable. For the pilot plant operation, bagasse is fed at a predetermined rate manually to the unit through a bucket elevator and screw conveyor system. Feed rate is governed by an indicating ammeter which shows the load on the driving motor.

An economic study of the operation indicates that it should be possible to operate a depithing plant at an overall cost of $0.40 per ton of mill run bagasse processed. This estimate is based on an assumed bagasse moisture of 49% and a separation of 20% by weight of the entering feed. The estimate includes not only actual operating costs, but also estimated maintenance costs, depreciation charges at 20% per year, overhead, and license fees. These cost data raise the question of the economic value of depithing bagasse.

The use of bagasse as a raw material for the production of pulp or wall board is complicated by the fact that in most areas of production the bagasse is produced seasonally. The length of the production period varies from approximately 2 1/2 months in Louisiana to as much as 5 to 6 months in some of the tropical areas. In a very few areas in the world bagasse production is continuous through out the year, but these are the exception. The seasonal production of bagasse plus the economic necessity for operating pulp and wall board mills on a year-round basis introduces the problem of storage of bagasse during periods of production to insure raw material throughout the balance of the year.

Storage problems are numerous and the operation is quite costly. Any money spent on this operation for material which does not appear in the finished product is in essence money lost.

In the production of even a relatively simple product such as wall board, about 20% by weight of the bagasse is lost during the manufacturing operation. These losses are principally in the form of dirt which was carried into the bagasse from the cane, and pith which is lost in the white water from the board or paper operation. Conservatively, losses from this source will be approximately 20% by weight on a dry fiber basis. The elimination or reduction of this loss prior to storage of the raw material. In addition, savings would be realized through greater capacity in the pulp and board mills and better yields from the material purchased. Experimental cooks made on depithed bagasse in comparison with whole bagasse by the Research Laboratory of a major paper company show that an approximately 10% higher yield of finished pulp can be expected from the depithed bagasse than from the whole bagasse. Estimated cost data on bagasse handling follows.

The following figures are conservative estimates of the cost of bagasse as a raw material at this time (7).

	Item	Cost/ton
1.	"Mill Run" bagasse, 50% moisture	$1.50
2.	Baling and stacking bagasse	3.00
3.	Removing baled bagasse from stacks to railroad cars	0.25
4.	Average railroad freight cost to market	1.60
5.	Total cost per ton "mill run" bagasse	6.35

If 20% by weight of the "mill run" bagasse is removed as pith and dirt prior to the baling and stacking operation, this material would not be subsequently lost in the processing of the bagasse into board pulp.

The material removed in the dry depithing operation would be returned to the sugar factory and used by the factory as fuel. This material would not be charged against the purchaser of bagasse since he did not actually receive it. We would, thus, recover from one and one quarter tons of "mill run" bagasse, one ton of cleaned depithed fiber. If a plant employs "mill run" bagasse, it would expend $7.94 to recover at the pulp mill the equivalent of one ton of fresh depithed "mill run" bagasse. On the other hand, should the "mill run" bagasse be depithed prior to baling and shipped to the wall board plant immediately, there would be a net saving to the fiber user of $1.09 per ton of raw material employed. As mentioned earlier, this does not include possible savings which would be the result of higher capacity on existing digestors, reduced chemical

costs and a better quality product.

Bagasse is not a cheap raw material under any conditions. Under conditions which prevail in Louisiana and which are common to many other areas the actual cost of the raw material at the sugar factory represents less than 30% of the delivered cost of the raw material at the wall board or paper plant. Anything which can be done to lower this cost will be of tremendous assistance is hastening the day when bagasse will be a much more competitive raw material in the wall board and the paper industries than is now the case. It is believed that the depithing process developed at the Louisiana State University is a very important step in the direction of lowered bagasse cost.

ACKNOWLEDGMENT

Acknowledgement is made of the advice and assistance of Dr. Paul M. Horton, Prof, Emeritus, Dept. Chemical Engineering, LSU, who is the co-inventor of the machine and processes mentioned above. The work of Drs. R. M. Hansen, Mark Fontaine, Mr. T.E. Linder, and the many other chemical engineering students of the University who assisted in the conduct of the reseach program is gratefully acknowledged. Special thanks are also due to the staff of the Audubon Sugar Factory who assisted with this work.

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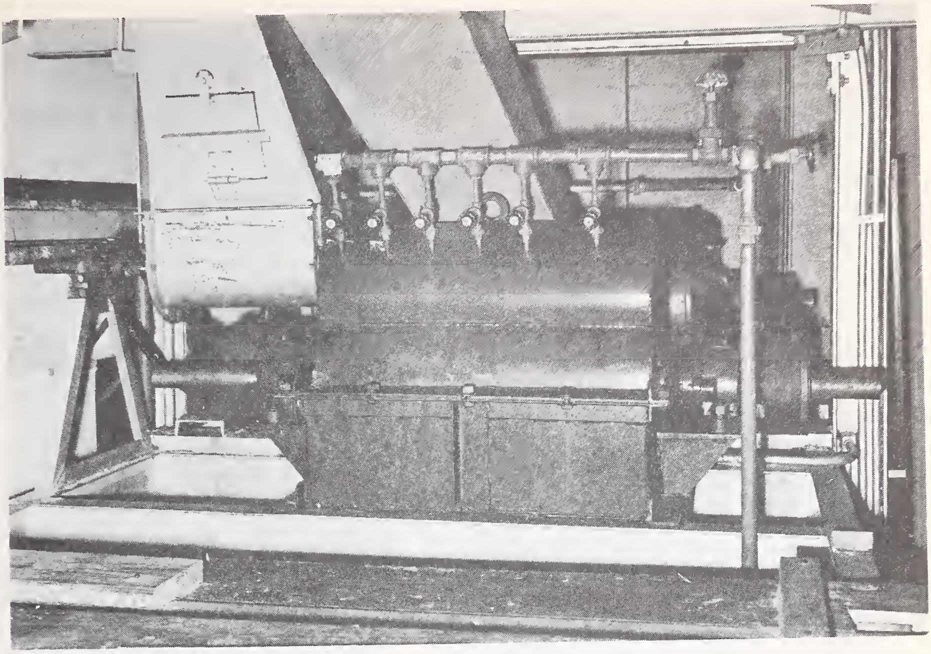

Plate I

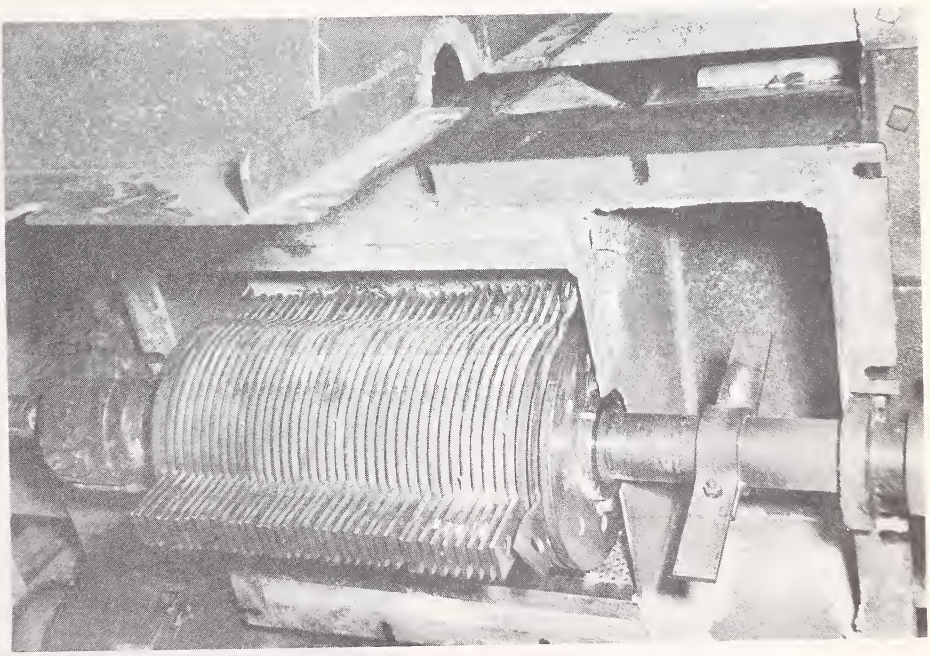

Plate II

Plate III

Plate IV

Plate V

SEPARATE TREATMENT OF THE FILTRATE JUICE FROM ROTARY VACUUM FILTERS

Fred L. Gayle

Introduction

It is customary in most sugar factories to return the filtrate from the vacuum filters to the mixed juice tank. Many sugar technologists have recognized that the mixing of the dilute juice with the filtrate is undesirable because of the introduction of impurities which have been previously removed from the mixed juice. Returning the filtrate to the mixed juice tanks means that colloidal material will be introduced into the mixed juice which will reduce the settling rate of the entire volume. By the recirculation of these undersirable colloidal impurities, it is generally conceded in the industry that sedimentation is retarded and clarifier capacity is reduced. It seems logical to assume that the proper approach to this problem would be to handle this material separately. Limited experiments have been tried in several factories using existing clarification equipment, such as open settlers, or various shaped tanks containing heating coils. This activity shows that the problem has been recognized as one of considerable importance to the industry.

These attempts have usually been approached as a problem of chemical treatment rather than on the basis of a pilot plant operation using properly designed equipment and chemical treatment. It was thought that a system of continuous and separate clarification of the filtrate juice using properly designed equipment and the necessary chemical treatment would be more economical and have a better chance of success. With this in mind, a Graverette clarifier was installed at Valentine Sugar Factory and test runs were conducted throughout the 1955 production season. The results obtained at Valentine were most gratifying. The juice from the Graverette was brilliant and of light color, and the mud heavily concentrated. The clear juice from the Graverette was sent to the evaporators and the mud returned to the vacuum filter.

Factory Operational Test at Valentine

A. Test Conditions. The average flow rate of the filtrate

juice from the vacuum filters was measured at 1,800 to 2,000 gallons per hour when the factory was grinding cane at the rate of 130 tons per hour. (The filtrate juice volume fluctuated with the amount of wash water used on the vacuum filters.)

B. Test Procedures. The filtrate juice was first treated with phosphoric acid, then limed to approximately 7.3 pH and heated in an open tank by injecting live steam. The filtrate overflowed from this tank directly into the Graverette clarifier. The clear juice from the clarifier was pumped directly to the evaporator charge tank.

The phosphoric acid was injected into the pipe line from the vacuum filters, and the lime was added at the mixing tank just prior to heating the filtrate.

Description of Equipment Used

The equipment included a 12 foot diameter, 3 compartment Graverette, having a capacity of approximately 9,200 gallons. In addition a rectangular mixing tank with a capacity of approximately 1,000 gallons, which was equipped with perforated steam pipes at various levels to provide each an agitation for floc formation.

Test Results

Laboratory test runs were made periodically and a six hour composite sample was used for these tests. The average analysis of a weekly test run is given below.

	Filtrate Juice to Graverette	Clarified Juice from Graverette	Mud From Graverette	
Brix	10.667	10.220	% Sucrose	7.51
Sucrose	8.043	7.904	Sp. Gr. Wt.	1.0605
Purity	75.330	78.100	Per. Gal.	8.825
Glucose	0.639	0.619	Solids	1.297
Glu. Ratio	7.940	7.820		
pH	6.010	6.980		
Clarity (Lux.)		48.000		
Glu. Dry	5.980	6.107		
T.S. Dry	81.31	84.210		
N.S. Dry	18.69	15,790		
Temp.	205-210			
pH After Lime	7.40			
N.S. Removal		15.52		
Ash		0.485		
Ash Dry Basis		4.54		

The above figures show that there was no increase in glucose ratio of the clarified juice, thus indicating that there was no inversion occuring in the clarifier. It is also interesting to note that the clarity of the clarified filtrate juice showed a luximeter reading equal to and in many instances better than the regular clarified juice. We suspect that the proper chemical treatment is partially responsible for such good results, and this could only be achieved by separate clarification. Another point of significance is that the filtrate juice shows a normal purity rise as might be expected on the mixed juice.

Observations on Operating Procedure

After the Graverette was put into operation and recirculation discontinued, it was observed that the mud level in the large clarifiers was easily maintained at a minimum height even during periods of heavy rain. This has been a difficulty in most factories during the rainy season in Louisiana. Although Valentine did not experience any difficulty with maintaining mud levels in the clarifiers, other factories in the same area found that it was necessary to either slow down or shut down operation for short periods during the rainy periods, as has been evidenced in the past production seasons.

It was also noted that by discontinuing recirculation there was a substantial increase in the capacity of the large clarifiers as might be expected. This provided additional clarification capacity for increasing the grinding rate, assuming that the balance of the boiling house will handle such an increase.

It was found that the filter cake could be washed more thoroughly, since there was no problem of increasing the volume of recirculated juice. And by increasing the wash water on the filter cake, the sucrose loss in the cake was considerably reduced; also the more dilute filtrate improved the settling in the Graverette clarifier.

Since Valentine factory produces a high quality turbinado sugar, they must have a clarified juice of superior quality in order to obtain this high grade sugar. After the first few days of experimental operation with the Graverette, it was found that the clarified juice was satisfactory for pumping directly to the evaporator charge tank and this operation was continued without interruptions during the grinding season. At no time was it necessary to recirculate the filtrate because of poor clarification.

Recommendation Pertaining to Factory Operation

Although manual operation of the phosphoric and lime feed could be controlled, it could be most desirable to use automatic control equipment for the addition of these chemicals in order to maintain proper pH control. Also a constant temperature regulator should be included on the mixing tank for maintaining the temperature of the juice flowing into the clarifier. Individual test showed that fluctuation in pH did not imperil the juice quality, but a small drop in temperature would affect juice clarity.

For best operating results in mud density control, it was found that a variable speed diaphram type sludge pump was necessary. The mud pump used on this experimental model was over-designed because a larger volume of filtrate juice had been anticipated, and it was necessary to operate the pump intermittently. This is always an undesirable operation and emphasizes the necessity of accurately estimating the filtrate flow rate prior to installing the equipment.

Some consideration was given to ditching the filtrate mud from the Graverette clarifier, but laboratory analyses showed that the mud contained an average of 7.5 per cent sucrose, and, therefore, the mud was returned to the vacuum filter mud tank reprocessing.

The test runs at Valentine over the entire production period showed that the chemical additive required (that is, phosphoric acid and lime) would cost a total of $2.60 per day for a factory operating at a capacity of approximately 3100 tons per day.

Operational Test in Other Countries

Similar operational test have been conducted on the same design equipment in Puerto Rico and Hawaii during the past two-year period. The results in Puerto Rico were not completed because of current labor problems involving factory personnel employment. However, during the ten day test run, the clarity of the filtrate was satisfactory for pumping directly to the evaporators, and no trouble was experienced. The juice was clean but contained a slight haze. This was partially attributed to the fact that the addition of the phosphoric acid and lime was accomplished by batch system and could not be effectively controlled.

In Hawaii, the experimental test runs are still in progress, but initial reports from the H.S.P.A. Experiment Station indicate that excellent results have been obtained.

Summary

We can definitely conclude that the separate treatment of the filtrate juice on a continuous basis is practical, is economical, and appears to be the best solution for eliminating filtrate recirculation.

Analytical Data on the Operation of Graveret Clarifier

at Valentine Sugar Factory - January, 1956

Filtrate to Graverete Before Lime

Date	Time	Brix	Sucrose %	Purity	Glucose %	Glucose Ratio	pH
1-4	12-6PM	8.60	6.38	74.19	.572	8.96	5.9
1-4	12-6AM	9.00	6.82	75.78	0.490	7.18	6.2
1-5	AM6-12	10.07	7.46	74.08	0.590	7.91	6.0
1-5	PM12-6	9.00	6.64	73.78	0.560	8.43	5.8
1-5	12-6AM	11.50	8.73	75.91	0.670	7.68	6.2
1-6	6-12N	10.44	7.97	76.34	0.660	8.29	6.0
1-6	12-6PM	10.50	7.96	75.81	0.61	7.66	6.0
1-6	12-6AM	12.10	9.24	76.36	0.68	7.35	6.1
1-7	6-12N	11.50	8.65	75.22	0.65	7.51	6.1
1-7	12-6PM	12.10	9.22	76.20	0.70	7.59	6.0
1-7	12-6AM	11.60	8.66	74,66	0.69	7.96	6.0
1-8	6-12N	11.10	8.39	75.59	0.67	8.11	6.0
1-8	6-12PM	*11.30	8.45	74.78	0.76	8.99	5.8
Average		10.677	8.043	75.33	0.639	7.94	6.01

Clarified from Graverette

Date	Time	Brix	Sucrose %	Purity	Glucose %	Glucose Ratio	pH
1-4	12-6PM	8.80	6.80	77.27	0.575	8.45	6.90
1-4	12-6AM	8.20	6.44	78.54	0.460	7.14	7.00
1-5	6-12AM	8.60	6.68	77.67	0.530	7.93	7.02
1-5	12-6PM	9.21	7.09	76.98	0.590	8.32	6.90
1-5	12-6AM	10.80	8.46	78.33	0.660	7.80	7.10
1-6	6-12AM	10.50	8.30	79.05	0.69	8.31	6.80
1-6	12-6PM	10.30	7.99	77.57	0.60	7.51	6.84
1-6	12-6AM	11.20	8.78	78.40	0.66	7.52	7.00
1-7	6-12N	10.80	8.55	79.16	0.63	7.40	6.90
1-7	12-6PM	11.10	8.73	78.65	0.65	7.45	7.01
1-7	12-6AM	10.95	8.53	77.90	0.64	7.50	7.00
1-8	6-12N	10.55	8.30	78.67	0.67	8.07	7.00
1-8	12-6PM	10.55	8.10	[illegible]	[illegible]	[illegible]	[illegible]
Average		10.22	7.904	78.10	0.619	7.82	6.98

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Data on the Operation of Graveret Clarifier
at Valentine Sugar Factory - January, 1956

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Filtrate to Graverete Before Lime

Clarity Luxi-meter	% Glucose Dry	Total Sugars Dry Basis	Non-Su-gars Dry Basis	Temp. Juice to Clari-fier	pH After Lime	Non-Sugar Removal %	
-	6.65	80.84	19.16	205-210	7.20		
-	6.44	81.22	18.78	"	7.32		
-	5.86	79.94	20.06	"	7.31		
-	6.22	80.00	20.00	"	7.40		
-	5.83	81.74	18.26	"	7.36		
-	6.32	82.66	17.34	"	7.4		
-	5.81	81.62	18.38	"	7.6		
-	5.67	82.03	17.97	"	7.3		
-	5.65	80.87	19.13	"	7.20		
-	5.79	81.99	18.01	"	7.25		
-	5.95	80.61	19.39	"	7.4		
-	6.06	81.65	18.35	"	7.5		
-	6.73	81.51	18.49	"	8.0		
	5.98	81.31	18.69		7.40		

Clarified from Graverete

Clarity Luxi-meter	% Glucose Dry	Total Sugars Dry Basis	Non-Su-gars Dry Basis	Temp. Juice to Clari-fier	pH After Lime	Non-Sugar Removal %	
50.	6.53	83.80	16.20			15.45	
48.	5.61	84.15	15.85			15.60	
48.	6.16	83.83	16.17			19.45	
50.	6.41	83.39	16.61			16.95	
48.	6.11	84.44	15.56			14.79	
50.	6.57	85.62	14.38			17.07	
48.	5.82	83.39	16.61			9.63	
45.	5.89	84.29	15.71			12.58	
45.	5.83	84.99	15.01			21.54	
47.	5.86	84.51	15.49			13.99	
48.	5.85	83.75	16.25			16.19	Overlimed
48.	6.35	85.02	14.98			18.37	"
50.	6.45	83.22	16.78			9.25	"
48.0	6.107	84.21	15.79			15.52	

Mixed Juice to Large Graver Clarifier

Date	Time	Brix	Sucrose %	Purity	Glucose %	Glucose Ratio	pH
1-4	6-12PM	12.36	9.55	77.26			
1-4	12-6AM	12.65	9.91	78.34	.73	7.39	-
1-5	6-12AM	13.05	10.42	79.85			-
1-5	12-6PM	12.00	9.51	79.25	.75	7.38	-
1-5	12-6AM	12.90	9.93	76.98	.72	7.60	-
1-6	AM6-12	13.80	10.88	78.84	.74	7.11	-
1-6	12-6PM	12.72	10.02	78.77			-
1-6	12-6AM	12.75	9.84	77.18	.72	7.20	-
1-7	6-12N	12.95	10.01	77.30	.77	7.76	-
1-7	12-6PM	12.90	9.92	76.90			-
1-7	12-6AM	13.40	10.35	77.24	0.81	7.97	-
1-8	6-12N	13.45	10.48	77.92			
1-8	12-6PM	13.43	10.77	80.19	0.83	7.97	-
Average		12.95	10.12	78.15	0.759	7.50	

Clarified Juice from Large Graver Clarifier

Date	Time	Brix	Sucrose %	Purity	Glucose %	Glucose Ratio	pH
1-4	6-12PM	11.90	9.61	80.76			6.30
1-4	12-6	11.70	9.51	81.28	.73	7.60	6.30
1-5	6-12AM	12.20	9.94	81.47			6.35
1-5	12-6	12.50	10.16	81.28	.73	7.51	6.30
1-5	12-6AM	12.26	9.91	80.83	.78	7.78	6.40
1-6	6-12	12.45	10.13	81.36	.72	7.18	6.20
1-6	12-6	12.75	10.40	81.57			6.20
1-6	12-6AM	12.48	10.17	81.49	.76	7.40	6.35
1-7	6-12N	12.23	9.85	80.54	.78	7.80	6.55
1-7	12-6PM	12.20	9.79	80.24			6.40
1-7	12-6AM	12.70	10.27	80.87	.81	8.08	6.25
1-8	6-12N	12.95	10.18	78.61			6.25
1-8	12-6PM	13.07	10.64	81.41	.83	8.12	6.30
Average		12.41	10.04	80.90	.768	7.65	6.32

Mixed Juice to Large Graver Clarifier

-continued-

Clarity Luxi-meter	% Glucose Dry	Total Sugar Dry Basis	Non-Sugars Dry Basis	% Non-Sugar Removal
-	5.77			
-		84.11	15.89	
-				
-	6.25	85.50	14.50	
-	5.58	82.56	17.44	
-	5.36	84.20	15.80	
-				
-	5.65	82.83	17.17	
-	5.94	82.24	17.76	
-				
-	6.04	83.28	16.72	
	6.18	86.37	13.63	
	5.86	84.01	15.99	
Clarified Juice From Large Graver Clarifier				
40.0				
48.0	6.25	87.53	12.47	21.5
40.0				
40.0		87.58	12.42	14.34
40.0	6.36	87.19	12.81	26.55
38.0	5.78	87.14	12.86	18.61
38.0				
43.0	6.10	87.59	12.41	27.72
42.0	6.38	86.92	13.08	26.35
40.0				
35.0	6.38	87.35	12.65	24.34
38.0				
38.0	6.35	87.76	12.24	10.19
	6.19	87.09	12.91	19.26

Mud From Graverete

Date	Time	% Sucrose	Specific Gravity
1-4	12-6PM	7.5	1.0630
1-4	12-6AM	6.0	1.0630
1-5	6-12AM	6.6	1.0500
1-5	12-6PM	6.6	1.0532
1-5	12-6AM	7.8	1.0682
1-6	6-12	7.8	1.0662
1-6	12-6PM	7.6	1.0560
1-6	12-6AM	8.3	1.0630
1-7	6-12N	7.9	1.0601
1-7	12-6PM	8.1	1.0622
1-7	12-6AM	8.1	1.0710
1-8	6-12N	7.5	1.0630
1-8	12-6PM	7.8	1.0480
Average		7.51	1.0605

Mud from Graver Clarifier

Date	Time	Sucrose %	Specific Gravity	Oliver Cake % Sucrose	Gallons Filtrate/hr.
1-4	12-6PM	8.2		2.6	1600-1800
1-4	12-6AM	7.6	1.0964	2.3	"
1-5	6-12	7.7	1.0830	1.9	"
1-5	12-6	7.8	1.0950		"
1-5	12-6AM	8.0	1.0774	3.0	"
1-6	6-12	6.4	1.0650		"
1-6	12-6	8.4	1.0910	3.90	"
1-6	6-12	8.2	1.0690	3.20	"
1-7	6-12	7.8	1.0670		"
1-7	12-6	8.6	1.0762	3.70	"
1-7	12-6	7.5	1.0716	3.40	"
1-8	6-12N	7.6	1.0716	3.45	"
1-8	12-6PM	8.8	1.0830	3.20	"
		7.890	1.0788	3.07	

THE "FAS FLO" FILTER AT GREENWOOD FACTORY

By Thomas Lowe

Most of the plantations that supply cane to Greenwood Factory have a considerable acreage of black land and clarification was a problem long before the advent of mechanical harvesting. The black land soil sticks to the cane much more tenaciously and since the particles are much smaller, they do not settle out well at all. The rotary vacuum filter is definitely weak in removing these fine particles and our mud and clarification problem has been serious and pressing for the past several years.

The clarification equipment at Greenwood consists of a 5-tray 20-foot Dorr, normally good for 2000 tons of cane a day and a 5-day Fortier rated at 1400 tons a day. There is one 8 x 14 foot Oliver Filter, which is inadequate for the usual grinding rate of 100-110 tons per hour. In dry weather the clarifiers and filter give little trouble, but for ten days or two weeks after a rain, we have more mud than the filter can handle and the recirculated finely suspended solids gradually build up in the clarifiers until only the top trays are running clear. When this point is reached, we have to reduce the grinding rate sometimes as much as 30% and at times have had to stop and liquidate a clarifier in order to eliminate the accumulated fine solids from the system.

Our neighbor at Supreme installed a Fas Flo filter for the 1954 crop and the results obtained were promising enough to justify our purchasing a 540 sq.ft. filter on a trial basis for the 1955 crop.

The Fas Flo is a pressure type leaf filter in which the leaves are horizontal and stationary. Each leaf has a 16 mesh aluminum backing screen and the filtering surface is a standard weight cotton filter cloth on top of this backing screen. Filtration takes place only on the top side of the leaf and this eliminates any possibility of cake falling off a leaf and causing cloudy filtrate. Two mixing tanks of about 1800 gallons capacity each are required and these tanks must have mechanical agitators and steam coils.

In operation, we run the cloudy filtrate from the Oliver into the Fas Flo mixing tank and add standard

"Hy Flo" filter aid at the rate of 50# per 1500 gallons of juice. After thorough mixing, the slurry is then pumped at 190°F into the Fas Flo filter, a small amount of milk of lime having been added so as to bring the pH up to about 7.8. The filtrate coming from the Fas Flo is turbid at first, but quickly clears up and is very bright and free of suspended matter and is sent direct to the evaporator supply tank. Pressure on the filter gradually builds up and at the end of one hour has usually reached 40# per sq. inch, at which point the filter is stopped. During the filtering cycle it is also possible to decant clear juice off the top of the filter at a rate of 5 to 7 G.P.M. This juice can be sent direct to the evaporator supply tank if watched carefully, but we played safe and returned it to the liming tank.

After the filtering cycle is completed, the filter is purged with air pressure and sweetened off with hot water. After the sweetening off operation the cake is removed from the filter leaves by a system of rotating hot water sprays. Each filter leaf has its own spray pipe directly above the leaf at a distance of 2". Hot water at 40# pressure is turned onto the sprays and the entire spray assembly is rotated by a small electric motor and reduction gear. The sluicing action of the water sprays is sufficient to clean all the cake from the cloth and the cake is run to waste in a slurry form. The cake runs about 6% sucrose and about 1500 lbs. of cake are produced per cycle.

We actually filtered one hour out of each cycle during which time the average flow was about 15 G.P.M. Draining out the filter, sweetening off, sluicing the cake and getting ready for the next cycle require a total of about 45 minutes, so that we actually made 13 to 14 cycles every 24 hours and filtered 9000 to 12000 gallons in this time. The average flow of cloudy filtrate from the Oliver was found to be 24 G.P.M. when grinding 100 tons per hour and not washing the cane on the carrier. By washing the cane on the carrier, we can reduce the volume of cloudy filtrate, but due to the shortage of evaporator capacity, we only wash when the cane is muddy.

We operated the filter during the entire 1955 crop. No extra labor was needed as the Oliver man looked after both the Oliver and the Fas Flo and the man who operates the lime mixing station attended to filling the Fas Flo mixing tanks and adding the Hy Flo.

Suchar Sales and Engineering sent two chemical engineers to start off the filter and run tests. One result of these tests was that we found the suspended solids in the cloudy filtrate from the Oliver was very high, being as much as one pound per gallon. This accounts for the fact that the cloudy filtrate can so easily "poison" the

clarifiers. We had no mechanical trouble with the filter except for stoppage of the spray nozzles and this was our fault as we failed to clean the accumulated rust from our hot water storage tank and the small particles of rust passed through the line strainer and plugged the orifices in the spray nozzles. We feel sure that cleaning and painting of the hot water tank this dead season will eliminate the nozzle trouble.

Cost of operating the filter was about $25.00 per day for Hy Flo, based on 14 bags of 50# each at $1.82 per bag. We did not need any extra labor, and one set of cloths lasted an entire crop. Cost of a set of cloth was approximately $250.00, made up as follows: Cloth, $127.00; Cotton rope, $8.00; Aluminun screen, $82.00; Labor, $33.00.

While the capacity of the filter was less than we had hoped for, our Oliver filtrate was so bad that we could not have expected any more of the filter. We filtered about 1000 gallons on each cycle and decanted 200 to 300 gallons more, thus relieving the clarifiers of around. 1200-1500 gallons of the worst material. It is easy to understand that this can be the difference between having the clarifiers keep ahead or having them gradually choke up with the fine material. In our case, we feel that this is actually what happened because in 24 hours, the Fas Flo eliminated from the system about 18000 gallons of the "poison" from the Oliver and this is quite a boost when the cane is muddy. Our clarifications troubles were not eliminated, but they were materially improved and we feel that with two Fas Flo filters, we could handle all of our cloudy filtrate and a good part of the so-called "clear" filtrate, and that by so doing, our clarification would be good regardless of weather conditions as long as our cane washing plant was operating reasonably well.

It is hard to compare one year against another, but in the 1954 crop our grinding rate was 100.49 tons per hour and we lost 12 hours and 55 minutes for clarifier trouble. In 1955 the grinding rate was 103.78 tons per hour and we lost one hour and 50 minutes for clarifier trouble and the filterability of our sugar improved from 69.5 to 71.6. The Fas Flo filter did not accomplish all of this, but it did make a substantial contribution.

WAREHOUSES AND WAREHOUSING OF BULK SUGAR

by

Alfred L. Webre, Jr.

In the switch-over from bag to bulk sugar storage which has occurred over the past years, a big majority of the Louisiana sugar houses have "made do" with their old bag warehouses. In such cases retaining walls were installed between columns, of whatever strength the designer deemed necessary. Many of us had our fingers burned in the process; almost every engineer or manager has tales to tell about what happened to their warehouse the first year that they filled it. It is the purpose of the first part of this paper to review this situation so that those who follow may have an empirical guide.

The basic problem is that the pressure against the wall at any given point is indeterminate and, probably, variable. It is easy enough to calculate the pressure at a point an appreciable distance from the wall. The height of the pile, in feet, multiplied by 50 lb./cu./ft., the bulk density of raw sugar, will equal the pressure at that point in lb./sq. ft. However, as soon as we approach the wall, which is the point of interest, two factors are introduced. First, there is adhesion of sugar to the wall which reduces the pressure in the zone by some unknown and variable amount. If the sugar is of large grain the adhesion will be less than if it is fine grain since adhesion is a surface phenomenon. Similarly, the moisture, and change in moisture, will affect the adhesion and hence the base pressure. Second, sugar is far from a perfect fluid so that the pressure is imperfectly transmitted, giving a further reduction in the pressure against the wall. Retention wall failures in the past have been largely due to an assumption, probably unconscious, that these two effects combine to reduce the wall pressure to a figure far lower than was actually the case. The facts seem to indicate that the pressure against the retaining wall at a depth of 16 feet may be of the order of 300-600 lb./sq. ft. Hence the structural failures when the buildings were not sufficiently strengthened.

One bay of a typical Louisiana bag warehouse consisted of something like 6 x 6 WF columns on 20-foot centers with a 60 or 70-foot span. To convert to bulk, additional 6 x 6 columns were added on 10-foot centers; additional 4" purlings

may or may not have been added. The retaining wall was either 1/4" plate or 2" thick wood. In either case, it was shored up from the outside using 4 x 6 and 6 x 6 timbers every five feet. Perhaps one or more walls of the warehouse was of conventional brick design, in which case it may or may not have been buttressed. In some cases preparations were made to run cables from one wall to another, making each wall a retainer for its opposite. With this preparation the crop got under way. However, the unfortunate manager discovered that if he went up only 10' against the wall as he had planned, his storage capacity was drastically cut. He found himself obliged to go up to perhaps 14-16 feet along the wall, and well into the trusses in the center. All went well for some period of time, but sooner or later the axe fell. In the case of the brick wall the result was spectacular and drastic: instantaneous and virtually total collapse. With the wood or steel sheath, the symptoms exhibited themselves more gradually in the form of ominous bulges; this gave the interested parties an opportunity to put up additional shoring in the weak spots. We will not repeat the sad story of twisted trusses and bowed columns that showed up when the warehouses were emptied. Suffice it to say that there was considerable money and effort expended in repairing and "beefing up" the structures. We know now that a masonry wall should be of reinforced concrete; a 10' wall should be 10" thick, which makes it too expensive for us to consider. The concensus seems to be that we should pile 16-18 feet along the walls; and at that height we need plenty of support for the first 10' of the wall. 6 x 2 x 13.0 channels used as purlings are indicated every 30". If you pile to 20 feet, they should be every 24". Now, consider the additional columns cannot offer their full strength since they are not tied to trusses. They had only their stiffness to offer since they have no structural strength in the direction of the sugar. It is indicated that the minimum requirement is 8 x 8 WF columns on maximum 8' centers, with a heavy buttress on each one. If a buttress is impractical some other method must be used to prevent the column from being pushed out. At Glenwood we are proposing to put a heavy anchor bolt and ring in the floor about 20' in front of each column. The columns will be tied to the rings with cables and turnbuckles. The cables and turnbuckles will be installed and removed as the pile proceeds and recedes. The external buttressing, if used, should be so designed as to give plenty of support to the lower parts where the pressure is greatest.

A word should be said about the distortion of trusses and overhead steel. Many of us have suffered it, and we have been inclined to lay the blame on piling the sugar too high above them. However, an examination of the stresses involved will show that the weight of sugar will not distort them in the direction that occurred. Further, a number of houses have piled sugar 8' and 10' into the trusses with no

ill effect. The writer has reached the conclusion that the distortion is brought about by an outward movement of the wall and/or columns at the end of the warehouse. Since most warehouses have their trusses tied together in some manner any displacement, or tendency to displacement, of the last truss is transmitted up the line with unpredictable results. It behooves anyone having this trouble to look carefully at the end columns and wall.

New warehouses, designed for the explicit purpose of storing bulk sugar, fall into two distinct categories in Louisiana, with possible combinations of the two.

(1) Bin warehouses. These are similar to our converted bag warehouses, with sugar piled up inside a retaining wall. In such a case, the columns can be designed of sufficient strength to obviate the necessity of buttressing and bracing the outside. It is a point of interest that in one such recent warehouse, the retaining wall is made of 1/8" crimped plate. The crimping is about 2" deep on 8" centers and runs vertically. This light material offers little strength and receives its rigidity from 6" junior I-beams used as purlings. These are placed on about 7-1/2" centers at the bottom of the wall, increasing to around 30" at the top, 16' above the floor. This type of sheathing is reported to be less expensive than 1/4" plate, being particularly rapid to install without welding. A crew of two trained men sheathed the warehouse 60 x 160 x 16 in less than three days.

(2) Angle-of-repose warehouses. This is simply a Quonsett hut type of structure with a heavy chain wall. The sugar is merely piled in the middle and seeks its natural cone shape without piling against the chain wall more than a few accidental inches. In essence this amounts to nothing more than a water-tight shed covering a pile of sugar. Aside from making sure that the floor can support the weight of sugar under the center of the pile, the engineer has no stresses to contend with other than those normally considered in an empty building.

The decision as to which type to choose is largely economic. The angle-of-repose will occupy more floor space in most cases the extra space is available and presents no problem. The height of the peak of the pile would be the same in either case. It would be dictated by the capacity of the soil to take the weight without settling. Please note that in stacking bag sugar the weight, and hence the pressure on the floor, was evenly distributed. In piling

bulk sugar the pressure on the floor reaches a maximum in the center, under the peak of the pile. Whichever type is chosen, this point must not be overlooked. In many Louisiana areas, with the peak as high as 30-35 feet above the floor, it is necessary to put in pilings, at least in a strip down the center of the warehouse. On top of that, a 6" slab of 5-bag concrete, mesh-reinforced, should have sufficient strength. Naturally, the slab should be waterproofed, first laying polyethylene plastic strips, or tarpaper, under the slab, and then adding a waterproofing compound to the mix.

Returning to the economic aspects, we are fortunate in having recent cost figures for contract design and construction of both types. The bin type ran \$8.40 per ton of warehousing capacity, while the angle-of-repose type ran \$6.60. If the capacity of the latter were increased by installing, say, a light 5' retaining wall, the cost would drop to about \$6.25. The advantage is obvious and needs no further elaboration. Incidentally, a bin type warehouse designed and erected by sugar-house personnel came to about \$6.00 per ton. No doubt a similar saving could be effected with the angle-of-repose type, bringing its cost to well below \$5.00.

* * *

No paper on this subject would be completed without a word about the actual process of placing the sugar in the warehouse, In general we have two main problems to solve. First, and potentially most dangerous, we must take steps to cool the sugar before piling. Temperatures above about 135°F tend to trigger an exothermic reaction in the film of molasses around each grain. The reaction raises the temperature further, which increases the reaction rate, which increases the temperature again, etc., a true chain reaction. The temperature may rise to the point of burning the sugar, bringing about a disastrous drop in pol and increase in color. For this reason the system for transferring the sugar from the boiling house to the warehouse should be examined. Those of us who transfer by truck and then pile with a sugar slinger have no problem since the various steps cool the sugar sufficiently. However, if a belt conveyor is used and the distance traversed small, steps should be taken as necessary to prevent occurrence of this phenomenon.

The second, and all-inclusive, problem is to prevent hardening. Again, hardening is an adhesion problem and is a function of the total surface of sugar crystals and the viscosity of the molasses film. Given sugar crystals of a certain size, the pile will harden and unharden as the film gives up or takes on moisture from the atmosphere. And so we find that as the relative humidity of the air

falls and rises with the weather, so our sugar crusts and uncrusts. Since we do not have prolonged periods of low atmospheric humidity which could dry up any amount of moisture in the film, we have to a great extent solved the problem by producing a sugar which has as high a moisture as our Factor of Safety allows. If that is not enough and the sugar cakes, we wait a few days for a change in weather and all is well. And if the weather does not change we introduce a little steam into the atmosphere of the warehouse, raising its relative humidity, and our sugar shortly softens up. Basically, however, there exists a very real conflict of interest, where our Factor of Safety tells us to make our sugar as dry as possible and our warehouse problem tells us to make it as moist as possible. In Louisiana we are fortunate that our mild climate makes a reasonable compromise possible. Other areas are not so fortunate, and extraordinary steps must be taken which are no concern of this paper.

* * *

In conclusion, let me thank the many persons who were kind enough to allow the writer to inspect their warehouses and discuss their problems in order to make this modest effort possible.

THE SUGAR INDUSTRY AND PURCHASED POWER

By J. D. O'Brien, Louisiana Power Light Company.

In the Louisiana Power Light Company service area on the West Bank of the Mississippi River, there are 19 sugar mills that operated during last year's grinding season. Two of these mills, besides being raw sugar producers, also refine raw sugar. At one time or another, all of these mills generated all or most of their electric power requirements during grinding season. Today, many of these mills have scrapped their generating equipment and depend entirely on our company for power. On the other hand, there are a number of raw sugar mills that generate practically all of their electric power during grinding season.

This situation has been the subject of some discussion among yourselves and might explain my appearance on your program this afternoon. In this paper, I propose to submit what I believe to be a verifiable explanation of why this situation exists and then explore some of the reasons why I think it would be impossible to justify the purchase of additional generating equipment in one of the raw sugar mills in our service area.

The birth of the electric industry, as we know it today, began with Edison's invention of the world's first practical electric lamp on October 21, 1879. During that same year, a machine for drying bagasse to prepare it for papermaking was put into operation on the B. A. Storey Plantation in St. Bernard Parish. To market his wonderful invention, Edison found it necessary to organize the world's first electric light company. On September 4, 1882, Edison's Pearl Street Station in New York City started serving the world's first 59 customers. Only a few years later, your industry was able to celebrate its centennial in Louisiana. About that time, E. H. Cunningham built a plant at Sugar Land, Texas, for making wrapping paper out of bagasse, and in 1888, the Tompkins Paper Company of New Orleans was shipping bagasse pulp to northern paper mills.

Edison's invention of the electric light marked the beginning of a new area. In the sugar mills, the replacement of the then existing light sources with electric lamps quite naturally resulted in the installation of some of the first electric generating equipment manufactured. Your industry was among the first to install dynamos after Edison invented the incandescent lamp; and one of these

early models is still tucked away in one corner of a sugar mill warehouse in our service area. This "do it yourself" tradition of your industry had led you to light your mills with your own "house current" long before America's first electric light companies were organized or ready to serve you.

When electric utility service first became available, power failures were frequent and restoration of service sometimes required hours instead of minutes as it does today. A quarter of century ago, "house current" was certainly more dependable than utility service in rural areas. Improvements in our transmission and distribution facilities have reversed this situation. There too was a time when the expression "I'll stick to my horse" was not only popular but justified.

When electric utility service first became available, it was priced considerably higher than it is today. Twenty-five years ago, your dollar bought far less electric energy than it does today; and it was smart to be thrifty with electricity. Again, this situation has reversed itself. In 1956, your dollar will purchase far less labor or raw material than in 1931; but because of a series of rate reductions buys more electricity than it ever did. Today, it is no longer wise to economize on your electric service.

In developing a sale, it sometimes becomes necessary for the seller to perform certain essential functions in the selling process or no sale results, regardless of the value of the article or service to the buyer. Now so far as I know, there has never been any consistent effort on the part of our industry to solicit your electric business. This factor, I believe, more than anything else explains why there is no uniform policy among the sugar mills in our service area toward purchased power. To understand why your electric business has not been consistently solicited requires understanding on your part of problems that are peculiar to our industry.

The purchase of five pounds or a hundred pounds of sugar at retail level by a single customer makes but little difference to either the grocer, the wholesaler or the refinery. Certainly, there is no change in the capital structure of any of the organizations involved. In the electric utility industry, the function of production, transportation and distribution are not performed by separate organizations, but by a single company. The addition of each new customer requires some capital expenditure however small. Admittedly, our company has made service available to a lot of rural, farm and residential customers where revenues did not justify the investment; we find ourselves financially unable to pursue a similar policy

toward our commercial and industrial customers.

Where many industries have been able to finance their growth out of internally generated funds, this has not been possible in the electric utility industry. The Federal Power Commission limits the electric utilities' rate of depreciation to about 3%, and in Louisiana, return on net utility capital investment is limited to 6%. Our company's rate of growth is about 10% annualy so that every seven years our loads double and recently we experienced this doubling of our load in the past five years. Limitations on our rate of return and depreciation of our capital investment have resulted in frequent trips to New York by our president for the purpose of financing the construction that is necessary to keep pace with our customers' needs for more power. It is, therefore most important that we conduct our operation in every way to earn the lowest possible interest rate on the money we borrow.

Our company's rate schedules were designed for the majority of our customers whose requirements for electric service are more or less uniform throughout the year. Without unfairly discriminating against our regular customers; we have made special provisions in our rate structure for the benefit of both our seasonal customers and customers having poor annual load factors because of large seasonal loads. While these special provisions sometimes result in a slightly higher unit cost per kwh for seasonal loads; our revenue per kw year is less from the seasonal customer than the regular customer.

Based on our system peak demand, our investment in distribution facilities amounts to 47.6% of our investment in electric utility plant. In the case of the seasonal customer, we also find that on a unit cost per kw basis, our investment in distribution facilities to serve this customer is usually higher because the primary line extension and substations installed to serve this class of customers can seldom be shared with other regular customers. These considerations explain why even though the seasonal load to be served is "off-Peak" and no new money is required for generation or transmission; the expected revenue may not be adequate to support the capital expenditure in local facilities required to render service. Thus, the power salesman who succeeds in selling a seasonal load quite often finds that he not only has the task of selling his customer but his own company as well.

In any business, there will always be occasions when managerial decisions on proposed capital investments are motivated by other concepts which tend to ignore the profit motive entirely. In your industry, there might have been some occasions when economic philosophy was not

a factor in deciding whether a further investment in electric generation would be justified. For example, a sense of social responsibility towards the community where the mill is situated might be a determining factor in justifying the purchase of additional generating equipment since a policy of local generation would provide more jobs.

Our industry sales philosophy is to sell as much of our customer's energy requirements as can be sold with profit to both buyer and seller. Our product, electric energy, has to be priced to meet the twofold objective of earning the legal return on the capital investment in facilities while being competitive with other energy sources. That our product is competitively priced is attested by the number of oilfield applications where the electric motor has displaced both diesel and gas engines and by the growing number of electric heating applications in our service area despite competition from cheap local fuels.

The process of extracting sugar from cane requires large amounts of energy in the form of both heat and power, and since its inception in Louisiana, fuel costs have been a matter of special concern in your industry. Projects to make paper out of bagasse that started out around 1880 were abandoned by the turn of the century because of the development of new burners which resulted in a higher heating value of bagasse as a fuel. Today, where bagasse is used in the manufacture of other products, it is my understanding that the mill receives as compensation the equivalent heating value of bagasse as a fuel. Thus, there is a tendency to regard bagasse as cheap by-product fuel which sometimes results in the assumption that all energy used in the sugar house that can be "home made" is cheap. Such assumptions often lead to economic waste. The mere availability of cheap by-product fuel does not mean that all of the steam this fuel produces is either free or cheap.

The possibility of further obtaining cheap by-product electricity in the sugar house from an extraction turbine having a heat rate of 4,000 to 5,000 BTU per kwh is very intriguing. In practice, the promise of cheap by-product electricity is seldom realized when accounting procedures are designed to corral all of the fixed and operating charges incidental to electric power production.

Every sugar mill in our service area that has capital frozen in electric generating equipment would economically and financially be in a better position to improve net operating profits if this equipment were scrapped and sold for whatever price it might fetch as junk. In those cases where this equipment was not fully depreciated, there would be a tax loss available which could be used to recover the capital frozen in electric plant. Use of low cost electric energy would result in the following important economic advantages to the sugar mill management:

(1) Capital required for electric plant could be used to earn a higher rate of return in your company's normal business. While our return is limited to 6%, many of our customers find opportunities in their own business to earn 20% on invested capital.

(2) With less capital invested in the sugar house because of the elimination of the electric plant, there would be a reduction in fixed charges to provide more economic flexibility to meet changing sugar quotas, process improvements, weather conditions and other operating hazards incidental to your business.

(3) With the elimination of problems incidental to the operation of the electric plant more time would be available to both management and operating personnel for the more important function of sugar production.

(4) Purchased power has a proven record of dependability and reliability in the sugar mills we now serve. These mills have no problem in trying to keep generating facilities going during disturbances of natural or human causes.

(5) Purchased power results in many hidden economics in other operating expenses resulting in increased operating profits.

If there is any doubt in your mind that electric power cannot be purchased more cheaply than you can generate it; I would submit for your careful appraisal the list of questions shown in Appendix 1. Although incomplete, these questions suggest that considerable investigation of the economics of steam utilization is necessary to get all the facts for a comparative cost statement on purchased power versus locally generated power. For most raw sugar mills, the economic appraisal of this question is far simpler than you might expect. When a tabulation of the direct operating expenses of generating power at the mill is not available, a short preliminary report based simply on estimated electric plant investment cost and estimated purchased power bills will illustrate the difficulty of trying to generate electric energy cheaper than you can buy it.

Let's consider a hypothetical case of a mill having electric power requirements as shown in Appendix 2. The grinding season demand was assumed to be ten times the demand during the dead season and to have a duration of about 75 days. Our company's general service rate schedule GS-1D along with seasonal rider D was applied to determine the cost of purchased power. In case "A", the mill purchases all of the electric power required. In case "B", purchased power costs are shown for the same mill furnishing all of its electric power requirements only

during grinding season. The possible reduction in purchased power cost seems worthwhile and a preliminary investigation is initiated.

The starting point of this investigation would be to determine the proper sizing of the proposed alternators. Our company's demand billing was based on the average load over a 15 minute period of maximum load and cannot be used to estimate generator size. Since the maximum instantaneous load governs the minimum generator size; an engineering study might indicate that as much as 2,000 kva be installed to provide adequate capacity to take care of the maximum instantaneous loads that might be imposed on the proposed electric plant. The replacement of across the line starters on motors larger than 15 h.p. with reduced voltage starters and the adoption of special starting sequences of all large motors after a shutdown might result in only 1200 kw in generating capacity being actually required. While this compromise would result in a lower capital investment in electric plant, the possibility of momentary generator overloads interrupting your power supply would increase operating problems at this mill.

Two 600 kw alternators would probably be recommended instead of one 1200 kw unit since utility stand-by power would not be available. The switchboard would be equipped with synchronizing equipment so that when the mill motors are being started up, both units would be in parallel operation.

Many other engineering problems relating to the over-all operation of this mill would, of course, have to be solved before a final decision were made to actually install electric generating equipment. However, let's assume that the next step would be to estimate the cost of installing two 600 kw turbines with alternators and all other necessary appurtenances. If, all new equipment is purchased; I would estimate the installed cost of this plant to be close to $300,000 and probably not less than $264,000. Use of second-hand equipment might reduce this proposed investment in electric plant to let's say $100,000.

Without proceeding furthur, it becomes at once evident that for this mill there would be no economic justification in attempting to generate their electric power requirements. Fixed charges on the capital invested would exceed the cost of purchased power. When fixed charges on the capital invested are less than 50% of the cost of purchased power, operating costs should be evaluated to determine whether there will be any savings available to amortize the proposed investment in electric plant. In cases where the estimated savings seems attractive, the impact of both Federal and State Income Taxes should be considered.

In this paper, I have tried to point up the fact that there is no economic justification for a continuing investment in electric power production equipment at any of the sugar mills in South Louisiana simply because this investment will not stand up on a true cost accounting basis. Familiarity with not only the technical problems, but with the economics and cost of power generation equipment available both in our industry and in your own makes this assertion self evident.

Appendix 1

Data required in the Preparation of an Economic Appraisal to Determine:

A. Your Capital Investment in Electric Production Equipment.

b. Your Annual Fixed and Operating Expense for Electric Energy.

Is your boilerhouse making steam for the sole purpose of operating an engine or a turbine because your requirements for process steam have been overstated? Are you satisfied that your processing equipment is being efficiently operated, or are leaks and radiation losses on the pan floor amplifying your requirements for process steam? Is the insulation on your high pressure piping being maintained? What happens to your condensate?

How much of your capital investment is frozen in electric generating equipment? Does your investment in electric plant include:

The additional cost of boilerhouse equipment required when live steam is used for electric power production?
Your additional investment in switchgear that would not be necessary if you were depending entirely on utility service?
Your investment in tools, parts and instruments for the repair, maintenance, testing and inspection of your electric power production equipment?
Your additional investement in materials and supplies required for electric energy production?
Your extra cost of reduced voltage starters that would not be necessary if you were buying power?
The extra cost of plant space required by extra boilerhouse auxiliaries, your generators and switchboard?
All of the labor, freight, supervision, engineering and other indirect costs originally expended to install your electric power plant facilities?

On your "Balance Sheet", are you able to include a sufficient "reserve for depreciation" of the funds invested in your electric production equipment? If so, how much are you setting aside for depreciation on your electric power plant?

How much money are you spending for insurance on your electric power production facilities? What kind of insurance are you buying for your electric plant? Are you fully protected in the event of a prolonged and unscheduled shutdown during grinding season while waiting for repair

parts? If your investment is not fully protected, how much more would insurance cost you to provide the indemnity you think you ought to have?

How much less would the tax bill on your mill be if you had no money frozen in electric power production equipment?

Is your accounting department systematically organized to assemble all of the many incidental expenditures chargeable to electric energy production in your mill? Are other plant expenses being charged to some other account? Does your electric production expense account cover:

All direct and indirect labor cost for electric power production with the additional charge for fringe benefits?
Executive supervision and extra accounting expense?
The extra cost of fuel for electric power?
All supplies and materials incidental to electric power production?
Expense for housekeeping and maintenance of the plant space occupied by your electric production plant?

TABLE 1 - Summary of Installed Cost of Electric Plant Facilities.

ITEM	EQUIPMENT	COST
1	Additional Investment in Steam Boilers, plus Boilerhouse Auxiliaries and Building Space	$________
2	Extraction Turbine, Alternator, Switchboard, Auxiliaries and Building Space (2 or more at)	$________
3	Additional cost of boilerhouse pumping equipment and water treating equipment plus Space	$________
4	Investment in Repair Parts, Tools, Testing Equipment and Warehouse Space	$________
5	Add 20% to the Sum of Items 1 thru 4 to cover construction, engineering, overhead, supervision, freight, insurance, etc.	$________
	TOTAL INVESTMENT IN ELECTRIC PLANT	$________

TABLE 2-- Operating Cost based on 15000 HR per YR

1	Fuel	$______
2	Labor, supervision	$______
3	Maintenance repairs	$______
4	Attendant labor	$______
5	Executive time	$______
6	Materials and supplies	$______
7	Property Taxes	$______
8	Insurance	$______
9	Depreciation	$______
10	Pre-Tax Return on Investment	$______
	TOTAL OPERATING EXPENSES FOR ELECTRIC ENERGY	$______

Appendix 2

Electric Power Data

Month	KW Demand	KWH Energy	Case "A" Billing	Case "B" Billing	Purchased Power Case "B" KW	Purchased Power Case "B" Kwh
Jan.	400	124,000	$1955.66	$177.38	40	4,000
Feb.	40	8,000	216.21	226.21	40	8,000
Mar.	40	8,000	216.21	226.21	40	8,000
Apri	40	8,000	216.21	226.21	40	8,000
May	40	8,000	216.21	226.21	40	8,000
June	40	8,000	216.21	226.21	40	8,000
July	40	8,000	216.21	226.21	40	8,000
Aug.	40	8,000	216.21	226.21	40	8,000
Sept.	40	8,000	216.21	226.21	40	8,000
Oct.	40	8,000	216.21	226.21	40	8,000
Nov.	400	240,000	2797.66	57.00	0	000
Dec.	400	240,000	2797.66	57.00	0	000
Totals	4800	676,000	$9496.87	$2322.27	400	76,000

Case "A" illustrates actual power cost for purchased power if this hypothetical mill buys all its power.

Case "B" illustrates actual power cost if this mill generates its electric power requirements during grinding season.

	Case "A"	Case "B"
Cost (¢/kwh)	1.405	3.055
Revenue ($/kw yr.)	23.74	58.05

TRACTOR TIRES USED IN THE SUGARCANE AREA

Robert J. Anderson

The increased cost of tires used on tractors in the sugar area has been alarming. Not only has the original cost of these tires increased steadily for the past five years, but the service life is much less than during the period previous to 1950.

The following are some comparative figures of tire cost and tire life for different periods.

	1946-49	1950-55
13-36 (11.26 x 36), Hi--Lug tractor tire. Cost	$107.00	$188.00
Usable tractor Service	3-4 yrs.	2-2 1/2 yrs
Tires available for use on wagons or other implements after lugs worn	60%	10%
Cost of wagon or implement tire. 9.00 x 36 or 11-36. Cost	$62.00	$100.00
Approximate percentage of worn tires used on wagons or implements.	60%	10%
Approximate life of worn tractor tires when converted to wagon or implement use	3-5 yrs.	3 yrs.

Note: Some tractor tires manufactured previous to 1947 are still being used on wagons and implements.

In addition to the loss incurred by these tires failing prematurely, and not lasting long enough on the tractor to wear the lugs to a point that they are no longer efficient for tractor use, these tires are not available as replacement tires on wagons or implements and this necessitates the purchase of new tires for this use. Worn tractor tires were well adapted to wagon and implement use, as they were heavier, had greater carrying capacity and resisted cuts and bruises because of their heavy rubber covering. I estimate the cost of tractor tire operation now is about 250% higher than it was in the 1946-49 period.

Tire Life:

Life of the tractor tires used in the cultivation of sugarcane has been reduced by almost 50% in the past five years. The life of a cane field tractor tire has been reduced from 3-4 years of efficient service during the period

previous to 1950, to a low 2 - 2 1/2 years of service during the period after 1950. This short life has not been caused by rapid tread wear, but by premature failure of the carcass or body of the tire. This condition has been caused by lack of care, or improper mounting, overloads, heavier implement and attachments, tires not designed for certain operations, supervisory personnel not educated to give proper instructions for care and maintenance under different operation conditions and carelessness.

There are some tires that were delivered on new tractors as original equipment in 1950, which are still in servicable condition. I have also observed many tires that have given four or more years satisfactory service on tractors. I see no reason why we cannot increase the life of our tractor tires by a program of supervision, maintenance and education. This part of our tractor maintenance has been sadly neglected, and this neglect has been very costly.

Field Operations:

There has been a number of changes in field operations in the past few years. These changes have had some effect on tire life. In most cases they have been ignored, and no effort made to meet them.

The following are some changes that have affected tire life:

1. Heavier implements requiring more strain on the lugs of tires in pulling them.
2. Fertilizer tanks mounted on tractors.
3. Longer distances traveled to and from work area.
4. Longer hauls at harvesting time.
5. The habit of operators of speeding tractors while going to and from work area. In most cases this is in excess of recommended speeds and is exceedingly dangerous when ammonia tanks are mounted on tractors.
6. The strain placed on tires operated under these conditions with heavy loads is much greater than any that they have to sustain in ordinary field operations.

Lug Design:

Previous to 1948 manufacturers of hi-lug tractors tires used different lug designs . These lugs were shorter, rounded at the edges, and the tread cross section was not as wide at the point of ground contact as their present tires. While those tires had less traction, they gave much longer service. Since then there has been a radical change in lug designs. The lugs are higher, more numerous, sharper, and the ground contact area has been greatly increased. This has improved the traction of these tires, but has also created a condition, which if not watched very

closely, can be the cause of considerable trouble, due to the greatly increased ground contact area. This tire has a very high resistance to side slip and pivoting, and under certain conditions this causes an abnormal strain to be placed on the side walls and lugs. When the tractor or implement equipped with this type tire is forced to make a very short turn, there is a noticeable buckling or twisting in the side-wall, due to the resistance offered by the lugs to pivoting. If the buckling and twisting continues, the sidewall of the tire will be weakened causing breaks to appear in the fabric on the inside of the tire, and the tire will fail prematurely. It is possible that the high resistance of the lugs to pivoting, may be the cause of lug separation that I have noticed in so many tires.

Care and Maintenance:

Supervisory personnel give very little attention to the care of tires. Operating personnel are not instructed properly in tire care and maintenance. Many tires are injured when they are installed or removed. New tires are installed on rims that are covered with rust. There is no regular check of air pressure. Personnel have not been impressed with the fact that different ply tires require different air pressure, and that the pressure varies with the weight of the implement carried on the tractor. The individuals responsible for the care and operation of this hi-lug tire should understand that this tire is a special tire, expensive, and due to its construction a few pounds variance in air pressure can damage it in just a few hours of operation.

There are many recommendations that could be made in regard to the proper care and maintenance of tires. To do this would require instructions in book length proportions, and would have to be changed to meet the requirements of different plantations. The above listed are the most important, and the ones that require the most attention.

RECENT STUDIES OF PARASITES OF THE SUGARCANE BORER AT THE HOUMA, LA. LABORATORY.

by
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The sugarcane borer, Diatraea saccharalis (F), is the most injurious insect attacking sugarcane in the United States. In Louisiana alone it causes an annual loss of about 5 million dollars. A number of attempts have been made by the entomologists of the Sugarcane Insect Research Lab. at Houma to obtain effective biological control of the borer . Some 13 species of parasites that attack the sugarcane borer and related species in this country or in foreign countries have been introduced at various times beginning in 1915. The introduction met with varying degrees of success. Two species, the Amazon fly, Metagonistylum minense, Towns., and the Cuban fly, Lixopaga diatraeae, Towns., were the most effective and were recovered for several years following their release, indicating their ability to survive the field conditions and winters that prevail in Louisiana. However, neither of these parasites increased in sufficient number to be of any value in borer control.

Present cultural practices and weather in Louisiana are considered to be more favorable for establishment and possible maintenance of larval parasites than they were during the periods 1915-20 and 1938-41 when most of the introductions were made. Borer emergence in the spring has been noticeably prolonged presumably due to earlier and more frequent disturbance of the soil by modern cultivation and fertilization practices adopted since the war years thereby accelerating borer development in exposed infested trash. Borer infestations have been increasing owing to increased planting of borer susceptible varieties of sugarcane; increased acreages of summer-planted cane, which usually becomes heavily infested before winter and successfully harbors a large winter population; more trash containing borers left in the fields due to the more uneven topping of sugarcane by mechanical harvesters limited scrapping due to general labor and mill shortage and mild winters.

It now seems likely that the Amazon and Cuban Flies will become adapted to Louisiana conditions and be of value in the control of the borer. Consequently additional numbers of these parasites are being introduced for

further testing.

Parasite puparia are purchased by the cooperating growers from J. A. Carmichael, Verdant Vale Estate, Arima, Trinidad, B.W.I. at 20 cents each and delivered by air mail to Houma. Upon receipt the puparia are placed in emergence boxes. As they emerge the flies are collected and transferred to mating cages. They are fed a mild water-sugar solution and split raisins. After a gestation period of 4-5 days the flies are released in the field in areas selected by surveys as having adequate population of the sugarcane borer in the right stage of development. Although most of the releases are made at the approximate per acre rate of 5 parasites, some are made at rates of 10, 15 and 25, if the borer infestation is sufficiently heavy.

In a test conducted in 1953, 2,491 Amazon and Cuban flies were released in selected localities on four plant-tations in the Houma area. Two of the localities were selected because of their proximity to fields scheduled for summer-planting, on the assumption that if the para-sites should become established, they would spread to the summer-plant and their overwintering possibilities would be increased. Both parasites became established in the four localities and gave an average combined fall per-centage parasitization of 36.1. Contrary to past records, the performance of the Cuban fly was more conspicious than that of the Amazon fly. There was a spectacular perform-ance of the Cuban fly at Dulac in a field in which 93 parasites were released on July 24. In a recovery collec-tion in October, consisting of 68 speciments, there was a parasitization of 63 percent. These encouraging results prompted a more vigorous program of parasite releases in 1954 and 1955.

During 1954, 10,614 Amazon and Cuban flies were released on 9 plantations in the Houma area. Both species became established on all the plantations with a combined average percentage parasitization of 28.8. In these tests, although the Amazon fly made up only about 1/3 of the released number the average parasitization by this species was 3.6% higher than the 12.6% for the Cuban fly.

In 1955, 25,748 Amazon and Cuban flies were released on 19 plantations. For reasons beyond our control, a good percentage of the parasites were undoubtedly received and released too late in the season for maximum effective-ness. Some of the releases were made as late as the first week in October. The late-season releases were made in mature sugarcane fields in the proximity of summer-plant, early fall plant, or fields, in which the cane had been used for seed and the secondary growth has become infest-ed with borers, to enhance the overwintering possibilities of the parasites.

Ninety release areas were surveyed during the fall of 1955 and a total of 2,546 borer stages and 657 Cuban fly puparia were collected. Percentage parasitization by this fly ranged from 0 to a high of 86.7 in some fields. The best results were obtained south of Houma on the Ashland group of plantations with a 46.4% parasitization; the Lower Terrebonne group was next best with 30.3, and Southdown Plantation third with 26.2. Although the average percentage parasitization for the season by the Cuban fly was 18.6, it is significant that it was 34.3% for 11 of the 19 release-plantations. There were no recoveries of the Amazon fly. This species had been recovered in August, however, in a preliminary examination in a release field. There were no significant differences in percentage of parasitization in the different per-acre rates of parasite releases. Release and recover data are summarized in Table 1.

Surveys to determine spread have shown that the Amazon fly became established in fields about 1 and 2 miles and the Cuban fly in fields 1/2, 1 and 2 miles from the nearest release points.

The Cuban fly has demonstrated ability to survive the winters in fields of unshaved summer-plant. Limited numbers have survived the 1953-54 and 1954-55 winters with minimum temperatures of 25 and 23°F., respectively. The best results of the 1954 season (a 75% parasitization) were obtained from an over-wintering population of the parasites on Woodlawn Plantation, Houma, La., which had received 548 parasites in 1953 and none in 1954. In another field 1/3 mile away there was a 45.5% parasitization from the same population. The highest parasitization of the 1955 season (86.7%) was also recorded in a 1954 unshaved field of summer-plant in which a 1954-55 overwintering population of the parasites was augmented with some 1955 liberations. There were no parasite recoveries in the spring of 1955 in trash examination in harvested fields and apparently no parasites carried over on two plantations on which there was no summer-plant, as determined by limited recovery collections in the fall.

Examinations for borer injury were made in 15 fields on 8 plantations in the 1955 harvest season. Data are given in Table 2. In the few fields examined the percentage of joints bored appeared to be higher in fields that were initially colonized that year, even with higher than average parasitizations, than in fields which received an accumulated benefit from the previous year's releases and also colonized in 1955. In the 1953-54 Cuban fly overwintering field of borer-susceptible variety CP36-13 (A-14), in which the 1954 joint infestation was 14.1% and the fall parasitization 75%, 1.5% of the joints were bored and the parasitization in 1955 was 67%. This was a phenomenal situation

for which it is rather doubtful that the parasite was altogether responsible. On the other hand this field is located in an area in which the borer infestation has been historically heavy. The infestation in the general area was apparently heavy again in 1955 as evidenced in a field of the same variety with 56.0 percent joint infestation on one side, and fields of another borer-susceptible variety, CP44-101, with joint infestations of 56.5 and 62.7% on the opposite side, all located about 1/2 mile away from the first field.

Miscellaneous Investigations: During 1954 and 1955, four species of miscellaneous stalk-borer and pink bollworm parasites from India were tested against the sugarcane borer. A total of 27,569 of these parasites were released on 10 sugarcane plantations and in a rice field. No establishment was recorded during the fall survey.

The Peruvian fly, <u>Paratheresia</u> <u>claripalpis</u>, (V.D.W.), another imported sugarcane borer larval parasite, is also being tested in Louisiana. During 1953-55, 598 parasites of this species from Mexico City and the British West Indies were released on several plantations in the Houma area. The parasite has not been recovered.

In 1955, the Cuban fly was tested against the sugarcane borer in rice. There were no recoveries in an examination in which 85 borer stages were collected.

Twenty-eight <u>Agathis</u> <u>stigmaterus</u> (Cresson), from Florida, were released on two plantations in 1955. This parasite is generally established in the Florida sugar cane area, having been introduced there in the 1930's. There were no recoveries during the fall survey to determine establishment.

1/ These studies were conducted in cooperation with the South Coast Corp., Southdown Sugars, Inc., Milliken and Farwell, Inc., Valentine Sugars, Inc., Lafourche Sugars, Inc,, Insect Identification & Parasite Introduction Section of Entomology Research Branch, USDA., American Sugar Cane League, Louisiana Agric. Expt. Station and Verdant Vale Estate, Arima, Trinidad, BWI.

Table 1. Releases and Recoveries of Sugarcane Borer Parasites in the Houma area.

Year	Number released: Amazon fly	Number released: Cuban fly	Number released: Total	Number of borers and parasites collected	% Parasitization by: Amazon fly	% Parasitization by: Cuban fly	% Parasitization by: Total
1953	1,082	1,409	2,491	706	10.9	25.2	36.1
1954	3,873	6,741	10,614	1,461	16.2	12.6	28.8
1955	1,043	24,705	25,748	3,203	0.0	18.6	18.6
Total or Average	5,998	32,855	38,853	5,370	9.0	18.8	27.8

Table 2. Parasite Survey and Sugarcane Borer Infestation Data obtained in fall of 1955 in the Houma, La. Area.

Plantations	Field Nos.	Releases per acre in 1954	Releases per acre in 1955	Percent parasitization in 1954	Percent parasitization in 1955	Total Stalks	Total joints	Percent joints bored
Point Farms	A-6	15	5	47.8	20.6	100	1224	22.0
Aragon-Sanders	B-2	5	5	37.5	54.8	100	1199	20.8
"	A-4	-	25	-	22.9	100	1287	28.3
"	B-1	-	10	-	35.6	100	1171	40.4
"	C-4	-	5	-	61.1	100	1208	22.1
Sarah-Lacache	A-8	-	5	-	7.1	100	1292	45.7
Presquille	B-9	-	25	-	26.1	100	1170	45.2
Mulbury	C-16	-	5	-	83.3	100	1257	44.1
"	C-17	-	5	-	66.0	100	1374	46.9
Ashland	C-29	-	10	-	86.7	100	1198	39.1*
"	B-6	-	5	-	63.6	100	1304	56.0
Woodlawn	A-14	0	10	75.0	66.7	200	2883	1.5**
"	C-30	-	10	-	30.2	100	1264	56.5
"	C-22	-	25	-	47.8	100	1317	62.7
Southdown	5	5	5	30.2	42.1	200	2431	16.1***

* 1954-55 Cuban fly overwintering field (1954 summer plant).

** 1953-54 Cuban fly overwintering field. 548 parasites released on this plantation in 1953. Percent joints bored in fall of 1954 - 14.1

*** Percent joints bored in fall of 1954 - 45.1

NEW DEVELOPMENTS IN WEED AND GRASS CONTROL IN SUGARCANE IN LOUISIANA

Ernest R. Stamper
Louisiana Agricultural Experiment Station

Weed and grass control in the sugarcane area of Louisiana was started in 1945 and 1946. At that time Johnson grass infestations in the sugarcane fields of Louisiana were a very serious problem. It was estimated in 1949 that at least 1/3 of the sugarcane producing acreage of Louisiana was so thoroughly infected that the yield of cane was materially decreased, and approximately 1/6 of the sugarcane producing acreage was so badly infested with Johnson grass that sugarcane production was marginal.

In 1947, studies were begun by the Louisiana Agricultural Experiment Station to obtain information necessary for a program to control this pest. These studies dealt with the population of Johnson grass seed in the soil over the sugarcane belt, the effect of fallow plowing and mowing on the eradication of large plants and their rhizomes, a search for chemicals, and combinations of chemicals, mechanical methods, and cultural practices. Over 50 different chemicals and formulations of chemicals have been tested for control of both Johnson grass seedlings and large Johnson grass plants. Most of the chemicals did not show sufficient promise to be worth large scale testing and were discarded. Some of the chemicals that showed promise in the beginning of the work in 1948 are still in use by sugarcane growers in Louisiana. These chemicals were TCA(trichloroacetate) and 2,4-D,)(amine formulation of 2,4-Dichlorophenoxyacetic acid).

Among the methods for the control of Johnson grass seedlings the use of 2,4-D followed within one week by flaming appeared to be feasible. Pentachlorophenol and some of the blended and refined oils also proved to be efficient if properly handled as post-emergence sprays for the control of Johnson grass seedlings. CMU(Karmex W.) has been erratic in the control of Johnson grass seedlings but has given good control of most broadleaf weeds and grass seedlings other than Johnson grass seedlings when properly used. Certain adjustments in the spray equipment differing from that regularly used with other chemicals is necessary for the application of CMU.

As information accumulated, it was published in the Sugar Bulletin, and distributed as mimeographed material by County Agents and the Louisiana Agricultural Experiment Station so that the information would be of value to those who were using or contemplating the use of control methods developed.

Fallow plowing, or continuous plowing of the land in the spring and summer when sugarcane is not grown, was started about 8 years ago and is still the cheapest and surest method available for the elimination of large Johnson grass plants and their rhizomes. Approximately 6 to 8 plowings are necessary for adequate control, and costs are estimated at $8 to $12 per acre. There has been no chemical substitute for fallow plowing nor is there a chemical showing promise for use instead of fallow plowing. It is not apparent that there is more gained from fallow plowing than merely controlling Johnson grass. Good tillage of the soil and good seed bed preparation before planting have been agronomic practices recommended for a number of years for good crop production. Fallow plowing makes the soil ready for good seed bed preparation in the plant cane year.

JOHNSON GRASS SEEDLING CONTROL

The control of Johnson grass seedlings was essential on many plantations that were practicing fallow plowing in 1948. In 1956, a control program is still essential on many plantations to protect the gains made in the control of Johnson grass in the past six years. No one knows at this time how long the practice will have to be continued.

The program for the control of Johnson grass seedling recommended in 1949 and 1950 was the use of 2,4-D plus flame cultivation. This method even though effective in controlling seedlings, is now obsolete. The lack of acceptance of this practice by the sugarcane growers lay in the fact that it required too much effort in properly timing the flame cultivation with the 2,4-D application. An all chemical program was desired by the sugarcane growers.

In 1951, the recommendation for the use of TCA plus 2,4-d for Johnson grass seedling control in plant cane was made. In the same year the recommendation to use 11 pounds of TCA plus 2,4-D on shaved stubble cane was also made for the control of large Johnson grass plants and their rhizomes. The basic program for the use of these materials has not changed in six years. It was realized in 1951 that the program was not an ideal one. However, if followed step by step as recommended, a high

level of control of seedlings can be obtained. The reduction and inhibition of the growth of Johnson grass rhizomes by the use of 11 pounds of TCA in shaved stubble in most years allowed the stubble cane to germinate and sucker so that a maximum number of sugarcane stalks could grow. The use of TCA in stubble has not been appreciated in the Johnson grass control program as much as in plant cane. Data and observations show that the use of TCA in stubble cane has been instrumental in increased yields of stubble cane and good insurance for gains obtained in control of Johnson grass seedlings in plant cane.

The recommended practice of using TCA plus 2,4-D in both plant cane and shaved stubble has been more effective in spring seasons with wet weather than with dry weather.

The owners, managers, and overseers that have followed the recommended practices where Johnson grass seedlings were a serious problem in 1949 have made gains in controlling Johnson grass and increasing sugarcane yields at less cost than originally spent for hand labor for hoeing. Not only has grass and weed control been obtained, but additional benefits have resulted. By controlling grasses and weeds, sugarcane plant populations have been increased and competition from the weed and grass is reduced. The elimination of weeds and grasses makes possible better cultivation and increases the efficiency of fertilizers and drainage.

A survey was made to determine the acreage of sugarcane in Louisiana treated with chemicals for the control of grass and weeds during 1955. This survey was conducted with the cooperation of the county agents in the eighteen sugarcane-producing parishes in Louisiana.

The results of this survey showed that on 120,193 acres of cane, or 45.8 percent of the total acreage, a complete (recommendation of L.S.U. Agricultural Experiment Station) chemical grass and weed control was being used. The survey also showed that on 73,473 acres, or 28 percent, 2,4-D alone or some other chemical control practice was being used. On a total of 193,666 acres or 73.8 percent of the acreage devoted to sugarcane some type of chemical grass and weed control program was being used.

NEW CHEMICALS AND CULTURAL PRACTICES FOR 1956 FOR WEED AND GRASS CONTROL

Of the new chemicals tested in the last three years there are three that have shown some promise in supplementing the present recommended practices for weed and grass control in sugarcane. These chemicals are:

1. Dalapon - Sodium 2,2-dichloropropionate.

2. 2,4,5-T-P-2(2,4,5-trichlorophenoxy) Propionic acid.

3. Amino triazole (A.T.)-3-amino-1,2,4-triazole.

The 2,4,5-T-P formulation was thought to have some properties that 2,4-D and 2,4,5-T might not have particularly in reducing the danger of drift to adjacent fields. In plant cane for the last two years this material has been compared to all other materials tested and has given superior yield, in both tons of cane and sugar per acre. The 2,4,5-T-P however, does not control Jonhson grass seedlings as well as some of the other materials tested. The control 2,4,5-T-P at the present time is about three times that of 2,4-D.

Amino triazole is one of the most interesting materials of the entire group of herbicides studied. The chemical acts as a bleaching agent in that it removes most of the chlorophyll (green coloring) from the plant but does not, in most cases, kill the plant. Amino triazole has shown promise in reducing the amount of Dalapon required to kill Johnson grass and Bermuda grass. If further studies show that this is true the use of Dalapon to control Johnson grass, Bermuda grass, and other grasses could be increased because of the increase in the safety factor to sugarcane. These chemical combinations will again be studied in 1956.

Among the several chemicals and combinations of chemicals tried on a field scale in the 1954 and 1955 growing season, Dalapon gave good results in killing Johnson grass in stubble cane. It also appeared promising as a control for Bermuda grass and other grasses. The experiments in 1954 and 1955 indicated that application rates for effective Johnson grass control in stubble cane were from 4 to 5 pounds of the commercially prepared product (85% sodiun salt). The test in the past two years also indicate that toxicity occurred where 6 pounds or more of Dalapon were used on the drill. Better results were obtained with Dalapon when applied following an early application of 11 pounds of TCA than when Dalapon alone was used.

Yields of stubble cane in 1955 were not significantly increased when Dalapon alone was used at the time or immediately following fertilization. Johnson grass usually germinates and starts to grow before the stubble cane germinates and tillers. Any condition that prevents early suckering of the shoots reduces the number of stalks of cane per acre and thus reduces the yield of sugarcane.

In test where the stubble cane was shaved, off-barred and sprayed with 11 pounds of TCA plus 1 pound of 2,4-D, the cane germinated and suckered well. This TCA treatment usually retards the growth of Johnson grass until May or about the time sugar cane is fertilized.

If the stubble cane is shaved, off-barred and sprayed with 11 pounds of TCA plus 1 pound of 2, 4-D, and Johnson grass has germinated and is growing at the time to fertilize a treatment of Dalapon at 4 to 5 pounds per acre on the drill should be tried to determine its value to the individual grower as an additional control. In tests where stubble was not shaved two applications of 2 to 2-1/2 pounds of 85 percent Dalapon on the drill has been effective in controlling Bermuda grass, red root or red bottom and other grasses.

Where plant cane is extremely grassy, 2 to 2-1/2 pounds of Dalapon has shown promise. Two applications in some cases have injured the sugarcane. If Dalapon should be tried in plant cane a directed spray should be used, to keep the spray on the grass and not on the sugar cane.

HAZARDS AND CAUTIONS IN THE USE OF SODIUM DALAPON AS A CHEMICAL HERBICIDE

Sodium Dalapon is a chemical that kills grass and sugarcane is a grass. There are indications that there is some difference in the amount of Dalapon required to kill Johnson grass and the amount that sugarcane will tolerate. Some varieties of sugarcane, C.P. 36-105, and C.P. 44-101, are more tolerant than other varieties to Dalapon.

Extreme care should be exercised in the application of Dalapon in sugarcane, or the gain to be obtained by controlling Johnson grass will be more than lost by injuring the sugar cane. Not more than 4 pounds per acre should be applied in stubble cane. Until further data are obtained with respect to Dalapon and its effects on weed, sugarcane, maturity and sucrose, its use should not be on any scale other than an experimental one, so that each individual grower becomes familiar with handling Dalapon.

The time of application of Dalapon is very importtant. It should be applied on Johnson grass not more than 8-12 inches high and before the Johnson grass has set flowers. Since Dalapon is not an effective broadleaf weed herbicide, 1 pound of 2,4-D should be used on the drill when Dalapon is applied.

The use of Sodium Dalapon for use in sugarcane has

been approved by the United States Department of Agriculture, Pesticide Regulation Section, in May 1955.

CAUTIONS IN THE USE OF RECOMMENDED CHEMICAL HERBICIDES

2,4-D is a plant killer. Extreme care should be taken to prevent the drift of this chemical in spray solutions to areas where sensitive plants such as cotton, bell peppers, ornamental shrubs, etc. are growing. The use of 2,4-D in areas where cotton is grown should be restricted to early spring before any cotton is planted or to the fall after cotton has been harvested.

The use of sodium chlorate can create a fire hazard and is also very corrosive to equipment. Care should be taken to change all clothing after sodium chlorate is used and calcium chloride should always be added as a safener. Smoking or open flames around sodium chlorate should be avoided. A sprayer used with this chemical should be thoroughly washed and cleaned.

TCA either as a concentrated liquid or powder will burn the skin. Care in Handling this chemical is important.

The recommendations on the manufacturer's label for handling all chemicals should be followed.

DEEP TILLAGE FOR SUGAR CANE PRODUCTION

By
I. L. Saveson and Z. F. Lund

Deep tillage of sugar cane production is a practice of growing interest in the cane country. This interest has been stimulated by reports of the benefits of deep tillage in other locations. Most of the sugar cane producers already have access to power units and tillage tools that enable them to break their soil deeply, if such a practice is advisable.

Deep tillage has resulted in rather pronounced increases in yield of cotton where soil compaction problems limit water intake and storage and limit root development. Such problems have been found to be rather widespread in the medium and coarse textured soils of the Mississippi River Valley that have been in continuous row crops for a long period of time. There are indications that the soil compaction problem is becoming more serious under the current system of management.

Research investigations were initiated in 1954 to determine the extent of soil compaction problems in the sugar cane producing area of Louisiana. These investigations were extended to cover all soil physical problems associated with restricted water and root movement in soil. Where soil problems were encountered several tillage methods for overcoming these problems were compared and evaluated. For these comparisons, the soil was broken by different methods in the late summer and the cane was planted in the fall of 1954. This is, therefore, a report of response during one growing season following treatment.

The effects of deep tillage on sugar cane yield and on soil physical properties were evaluated in tests on Cinclare Plantation at Cinclare, Louisiana. Sugar cane yield was used as an indication of response to deep tillage at three additional locations. These were on Glenwood Plantation at Napoleonville, Louisiana; Upper Ten Plantation at Raceland, Louisiana; and Duhe Plantation at Jenerette, Louisiana. All measurements were made approximately sixteen months after the soil was tilled

Sugar cane yields were measured as standard tons of sugar cane per acre; bulk density as grams of soil per cubic centimeter in undisturbed soil cores removed from

the plots; permeability as the velocity of water in inches per hour through saturated cores of undisturbed soil; and large pores as the fraction drained when a saturated core of undisturbed soil was placed on a tension table and subjected to a tension of 50 centimeters of water for 24 hours. Particle size analysis by the Hydrometer method was used to identify the soil texture and as an index of uniformity of texture over the plot area.

Three deep tillage methods were compared to the conventional methods of breaking. The conventional method consisted of reversing the rows after fallowing. One deep tillage method consisted of shattering the soil with subsurface sweeps operated 13-1/2 inches and 18 inches deep simultaneously. The sweeps were set to impart a 2-1/2 inch lift to the soil as they moved through it. The second deep tillage method consisted of turning and setting the top 18 inches of soil on edge by deep moldboard plowing. A modification of this method was used at some locations which consisted of turning and setting the top 10 inches of soil on edge with one trip of a moldboard plow and then replowing 18 inches deep in the opposite direction with a second trip of the moldboard plow. The third deep tillage method consisted of mixing the top 14 inches of soil with a series of closely spaced chisels.

The effect of tillage method on sugar cane yield, as shown by Table I, was rather small. There was a trend toward increased yields for lifting the soil with subsurface sweeps and for turning the surface soil and setting it on edge. Generally the rainfall was sufficient in amount and distribution to prevent any appreciable soil moisture stress during the 1955 crop season. Response to tillage in other areas has been attributed to greater storage of moisture in the root zone of deeply tilled areas. Such response has been negligible during years of abundant rainfall. Yield response during years of subnormal rainfall will be required to determine whether or not there will be similar response in the cane country.

At Cinclare, Louisiana, the method of tillage had no effect on bulk density, pore space, or permeability of the surface 15 inches of clay soil. On sandy clay loam, however, bulk density was reduced from 1.47 grams per cubic centimeter in conventional tilled areas down to 1.45 grams per cubic centimeter by mixing with close-spaced chisels, to 1.34 grams per cubic centimeter by lifting with subsurface sweeps, and to 1.33 grams per cubic centimeter by turning and setting the surface soil on edge with a moldboard plow. Accompanying the decrease in bulk density there was a corresponding increase in total porosity.

The most profound effect of reduced bulk density was the increase in permeability in the sandy clay loam soil.

Permeability was .13 inches per hour on conventionally tilled plots. It was increased to .33 inches per hour by mixing the surface 14 inches of soil with chisels, to .94 inches per hour by lifting the surface 18 inches of soil with subsurface sweeps, and to .95 inches per hour by turning the surface 18 inches of soil and setting it on edge with a moldboard plow.

Particle size analysis indicated that the clay soil area had a fairly uniform texture but that some of the plots in the sandy clay loam area contained considerably more clay than others.

These data suggest that yield response to deep tillage might be expected on sandy clay loam soil in moisture deficient years. The response on clay soil may be a lesser amount. Investigations will be continued on these areas and extended to additional areas as time permits.

TABLE I. The Effect of Tillage Method on Sugar Cane Field

Location	Soil Texture	Method of Tillage			
		Conventional[1]	Lifted[2]	Mixed[3]	Edged[4]
		Standard Tons of Cane Per Acre			
Cinclare	Clay	32.0	36.4	31.3	32.5
Cinclare	Sandy Clay Loam	33.2	32.9	33.3	35.3
Napoleonville	Clay	23.3	23.5	23.3	24.4
Raceland	Clay	28.8	30.3	30.8	32.6
Jeanerette	Clay	29.4	30.1	30.5	31.5

[1] Reversing the rows after fallowing.

[2] Lifting the top 18 inches of soil with subsurface sweeps.

[3] Mixing the top 14 inches of soil with closely spaced chisels.

[4] Turning and setting the top 18 inches of soil on edge.

PANEL DISCUSSION
HEAT TREATING OF SEED CANE FOR CONTROL OF RATOON STUNTING DISEASE

QUESTIONS;

1. Type of treating unit used
   A. Number of units operated - 1954-1955
   B. Source of heat
   C. Capacity per unit

2. Temperature range at which cane was treated
   A. Time needed to reach effective temperature
   B. Time held at effective temperature
   C. Highest temperature reached

3. Costs of operation
   A. Estimated cost of unit
   B. Labor cost per day or per batch
   C. Estimated cost per ton of treating (Depreciate unit at 15%)

4. Any specific trouble or "bugs" encountered in the treating procedure.

5. Tons of cane treated, by variety - 1954-1955

6. Acres planted, with treated seed, by variety - 1954-1955

7. Acres planted in 1955 with progeny of seed treated in 1954

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties.

9. Observations on growth and yield of cane treated in 1954
   A. Planting ratio obtained from seed treated in 1954
   B. Germination of seed cane, progeny of cane treated in 1954.

10. Observations on effectiveness of treatment
    A. Necessary precautions to prevent contamination
    B. Long range program to preserve seed plots of disease free seed.

11. General discussion on field practices
    A. Dates of treatment and planting
    B. Rate of planting
    C. Depth covered
    D. Chemical Weed control
    E. Winter cover crop
    F. Spring cultivation. Shaved or hoed-Chemical Weed Control

HEAT TREATING OF SEED CANE FOR CONTROL OF RATOON STUNTING DISEASE (SCLEROSPORA) AS PRACTICED ON GODCHAUX SUGARS, INC. RIVER GROUP PLANTATIONS AT RESERVE

By J. V. Fourmy

Question:

1. Type of treating unit used
    - A. Number of units operated 1954-1955
    - B. Source of heat
    - C. Capacity per unit

Answer:

1.
    - A. Raw Sugar bag washing tanks at Reserve Refinery are used to heat treat seed cane on the weekends when the factory is not operating.

    - B. Hot water is the source of heat used for treating this seed cane. Steam is available for maintaining the required water temperature, but we have found that hot water circulating through the tanks maintains the temperature more satisfactorily.

    - C. The capacity of our unit is about 20 tons per 24 hours.

Question:

2. Temperature range at which cane was treated
    - A. Time needed to reach effective temperature
    - B. Time held at effective temperature
    - C. Highest temperature reached

Answer:

2. The temperature range at which the seed cane is treated is 51 to 52-1/2 degrees centigrade.

    - A. We reach our effective temperature, 52 degrees, immediately, as the circulating hot water is regulated to so maintain that temperature.

    - B. Two hours is the required time for treatment at the effective temperature of 52 degrees Centigrade.

C. Temperature should not exceed the 52 degree effective temperature, except momentarily at times, and likewise the temperature should not fall below the 52 degree mark.

Question:

3. Cost of operation
   A. Estimated cost of unit
   B. Time held at effective temperature
   C. Highest temperature reached

Answer:

3. A. The estimated cost of a similar unit with the same capacity is between $1,500.00 and $1,800.00. We are installing a hot water heat treating unit at Raceland this summer.

   B. Labor cost of operating our unit amount to $100.00 per 24 hour period.

   C. Heat treating our seed cane cost approximately $5.00 per ton. There is no depreciation included in this cost.

Question:

4. Any specific trouble of "bugs" encountered in the treating procedure.

Answer:

4. In our operation there was no specific trouble encountered after we extended a trolley to facilitate handling the cane from the cane trailer to the tank trolley. Strict supervision is necessary to maintain the constant temperature.

Question:

5. Tons of cane treated, by variety 1954-1955.

Answer:

5. In 1954 we were experimenting with the hot water operation and also treated a small amount of cane with the heat treating unit from L.S.U. No definite determination was made as to tons of cane treated by each operation. However, we planted approximately 9.36 acres of heat treated seed in 1954. In 1955, we heat treated (with no water) approximately 22 tons of CP 44-101; 14 tons of CP 36-105; and 4 tons of CP 36-13 or a total of approximately 40 tons.

Question:

6. Acres planted, with treated seed, by variety, 1954-1955

Answer:

6. From the heat treated seed in 1955 we planted 6.3 acres of CP 44-101; 4.0 acres of CP 36-105; and 1.1 acres of CP 36-13 or a total of 11.40 acres of cane.

Question:

7. Acres planted in 1955 with progeny of seed treated in 1954

Answer:

7. In 1955, we planted 90.60 acres of cane from the progeny of 9.36 acres of 1954 heat treated cane.

Question:

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties

Answer:

8. Our observations in 1955 were that there was no material difference in germination of the different varieties. However, we did notice that the germination in the progeny cane was much heavier than in the heat treated cane. This could be that some of the weaker and less mature eyes were somewhat damaged by the heat treatment.

Question:

9. Observations on growth and yield of cane treated in 1954
   A. Planting ratio obtained from seed treated in 1954
   B. Germination of seed cane, progeny of cane treated in 1954

Answer:

9. The growth and yield of the 1954 treated cane was excellent.

   A. The ratio of planting from the 1954 treated seed was 9.68 to 1. At that time our field run cane was planting 7 to 1.

B. Germination of the seed cane in 1954 progeny was very good; far superior to the surrounding field run cane.

Question:

10. Observations on effectiveness of treatment
    A. Necessary precautions to prevent contamination
    B. Long range program to preserve seed plots of disease free seed.

Answer:

10 When the 1954 treated cane had matured, it was far superior to the surrounding field run cane in growth, tonnage yield, and size of barrel.

   A. All necessary precautions were taken to prevent reinfesting the disease free cane. All knives, shaver blades, plows, and other tools were sterilized with lysol to prevent reinfestation.
   B. Every equipment should be taken to keep all contaminated equipment and tools out of the disease free cane.

Question:

11. General discussion on field practices
    A. Dates of treatment and planting
    B. Rate of planting
    C. Depth covered
    D. Chemical weed control
    E. Winter cover crop
    F. Spring cultivation. Shaved or hoed-Chemical Weed Control

Answer:

11. A. The heat treatment operation was carried on August 20 cane planted August 22; treated September 3; and planted September 5.

    B. Rate of planting was two stalks.

    C. At planting, the cane was covered to a depth of about 3 inches.

    D. The chemical weed control consisted of 1 lb. of 2-4,D and 5 lbs. T.C.A.

    E. Melilotus Indica cover crop was used in the Fall.

    F. Spring cultivation the cane was shaved and sprayed with 1 lb. of 2-4,D and 5 lbs. of T.C.A.

Presented by L. C. Bourgeois

Question:

1. Type of treating unit used

    A. Number of units operated-1954-1955
    B. Source of heat
    C. Capacity per unit

Answer:

1. Hot Air

    A. 1954-League unit, 1955-1
    B. Electric heating cones
    C. 2500-3000 lbs. - Av. 1.44 tons

Question:

2. Temperature range at which cane was treated

    A. Time needed to reach effective temperature
    B. Time held at effective temperature
    C. Highest temperature reached

Answer:

2. 57-58°C

    A. 3 hours
    B. 5 hours
    C. 62° momentarily

Question:

3. Cost of operation

    A. Estimated cost of unit
    B. Labor cost per day or per batch
    C. Estimated cost per ton of treating (Depreciate unit at 15%)

Answer:

3. Cost of operation

    A. $1,050.00

B. Per Batch - $10.80; per ton - $7.70
(Labor includes loading in field and dropping in planting furrow)

C. Estimated cost per ton including depreciation, labor, supervision, and miscellaneous - $12.85

Question:

4. Any specific trouble or "bugs" encountered in the treating procedure.

Answer:

Unit operated very well with good distribution of Air throughout the box. Our greatest difficulty encountered was in manipulating rack after it was loaded, getting it into and out of box. About six men were required for this operation. In my opinion this feature needs much improvement in our case.

Question:

5. Tons of cane treated by variety - 1954-55

Answer:

1954 - No information available. Portable League unit was used.
1955 - CP44/101 - 32.17 tons, CP48/103 - 7.75 tons, NCO - 310 --9.31 tons.
Total - 49.23 tons.

Question:

6. Acres planted, with treated seed, by variety - 1954-55

Answer:

1954 - CP44/101 - 1.70 acres, CP36/105 - 2.00 acres
1955 - CP44/101 - 8.25 acres, CP48/103 - 2.20 acres, NCO 310 - 2.47 acres
Total 12.91 acres

Question:

7. Acres planted in 1955 with progeny of seed treated in 1954

Answer:

CP44/101 - 4.45 acres, CP36/105 - 7.70 acres. All cane available to us after League distribution was planted; our acreage planted in 1955 from 1954 treated seed represents, therefore, only a part of the acreage increase.

Question:

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties.

Answer:

It has been our experience that treated seed has not germinated as well as field run seed. There has been observed at times a marked difference in germination from different batches. The germination in 1954 was especially poor, some entire rows having only a few scattered stools of cane. Germination in 1955 was much better, but not up to the general field run plantings. We consider it only natural that seed cane that is handled so much must of necessity suffer some physical damage to the eyes. In addition the heat treatment when hot enough to be effective in controlling the disease is bound to cause some damage.

A. Our experience has been that CP44/101 gave the poorest germination, both in 1954 and 1955. Other varieties treated seemed about equal.

Question:

9. Observations on growth and yield of cane treated in 1954
   A. Planting ratio obtained from seed treated in 1954
   B. Germination of seed cane, progeny of cane treated in 1954

Answer:

Our experience was that although we had a very gappy stand, the growth in 1955 of the CP36/105 was slightly superior to field run cane, In the case of CP44/101, the stand was very inferior, and frankly we could not observe any superiority in growth. As a matter of fact, it seemed somewhat inferior to the field run cane.

A. No data available as part of the seed was distributed through the League to other growers.

B. In both case of the 36/105 and the 44/101, we have obtained an excellent stand and a very promising early spring growth.

Question:

10. Observations on effectiveness of treatment

 A. Necessary precautions to prevent contamination
 B. Long range program to preserve seed plots of disease free seed

Answer:

Field inspection by Dr. Chilton and Mr. Lauden in August of 1955 indicated that the treatment had been very effective.

A. All knives-hand, cane harvester, or shaver knives are thoroughly disinfected before use in treated cane. Carts and/or slings used in transport of cane are disinfected, and in handling seed cane to be treated, a separate cart is used for the transport of the treated seed to the field.

B. We do not expect the treatment to be 100% effective, nor do we expect cane, once treated to remain free of disease indefinitely, since we know that despite all precautions some reinfestation will occur. Our aim in starting to treat seed was to reach the point in three years when we would have enough disease free seed for our entire planting program. Having reached that point in 1957 we cannot then afford to sit back, and say "Well now we are rid of Ratoon Stunting Disease". We plan to continue our treating operations so as to have a continued supply of treated seed, and of first year progeny from treated seed, to feed into our seed supply. This necessitates long range planning as to varietal distribution. We feel that in the case of newly released varieties, the seed should be heat treated the first or second year after release, depending upon the amount of seed available and how rapidly we wish to increase a given variety.

Question:

11. General Discussion on field practices

 A. Dates of treatment and planting
 B. Rate of planting
 C. Depth covered
 D. Chemical weed control
 E. Winter cover crop
 F. Spring cultivation. Shaved or hoed - Chemical Weed Control.

Answer:

11. General discussion of field practices

    A. Started treating August 31, 1955, stopped September 27, 1955. Cane was planted same day treated or at latest, the following day.

    B Two stalks, and a slight lap.

    C. 3 to 4 inches.

    D. Sprayed in Fall at rate of 2# per acre -2,4-D.

    E. A winter crop of Austrian Winter Peas was planted along shoulders of row.

    F. Followed the routine Spring cultivation, except that no shavers were used. Plots were hand hoed and then sprayed as previously indicated. One application of Anhydrous Ammonia at the rate of 45 units of N. per acre has been applied, and will be followed with a second application at the same rate.

Presented by Louis L. Arceneaux

Question:

1. Type of treating unit used

   A. Number of units operated - 1954-1955
   B. Source of heat
   C. Capacity per unit

Answer:

1. Electric Unit No. 2

   A. Treated cane with League Mobile unit in 1954. Smithfield had 2 electrical units operating in 1955.

   B. Electricity.

   C. One and a fourth (1-1/4) ton per unit (1-1/4 tons)

Question:

2. Temperature range at which cane was treated

   A. Time needed to reach effective temperature
   B. Time held at effective temperature
   C. Highest temperature reached

Answer:

2. 57^{o} to 59^{o} Centigrade

   A. Four hours

   B. Four hours

   C. 59^{o} Centigrade

Question:

3. Costs of operation

   A. Estimated cost of unit
   B. Labor cost per day or per batch
   C. Estimated cost per ton of treating (Depreciate unit at 15%)

Answer:

3. $1,000.00 per unit, One thousand dollars.

   B. Labor cost for treating and planting amounted to approximately $9.30 per batch.

   C. About $12.50 to $13.00 per ton. However, this figure may vary one way or the other, depending on cost of electricity per KW H under various contracts with Company furnishing electricity and type of field organization in operation.

Question:

4. Any specific trouble or "bugs" encountered in the treating procedure.

Answer:

4. No serious trouble, however, we noticed that the cane had to be properly stacked in box, letting plenty enough space for air circulation. We also had to be sure that all of our deflectors would remain in proper position at all times, otherwise the air would not be distributed evenly in box.

Question:

5. Tons of cane treated, by variety - 1954-55

Answer:

5. The following cane treated by American Sugarcane League Unit in 1954: 36-105, 5 tons; 44-101, 5.3 tons; 43-47, 0.75 tons; NCo 310, 0.70 tons; 44-155, 0.70 tons; total - 12.45 tons. We discarded several hundred pounds of each of the mentioned varieties due to not being able to bring temperature up in several bins of treating unit.
   During fall of 1955, we treated the following varieties with two #2 electric units: 44-101, 26.5 tons; 36-105, 31.0 tons; 36-13, 55.0 tons, 48-103, 9.0 tons; 47-193, 7.5 tons; 29-320, 5.0 tons; total - 134 tons.

Question:

6. Acres planted, with treated seed, by variety - 1954-1955

Answer:

6. Acres planted 1954 with following varieties: 36-105, 2.00 acres; 43-47, 0.33 acres; 44-101, 2.20 acres; NCo 310, 0.30 acres; 44-155, 0.30 acres; total - 5.13 acres.
   Acres planted in 1955 with treated seed: 36-105, 12.70 acres; 44-101, 11.80 acres; 36-13, 19.90 acres; 48-103, 2.53 acres; 47-193, 4.57 acres; 29-320, 2.30 acres; total - 53.80 acres.
   We had a very good stand in all treated varieties in the fall, except variety 29-320. We had a very poor fall stand variety 29-320. However, this was kept in heating unit about 10 hours instead of regular time of 8 hours.

Question:

7. Acres planted in 1955 with progeny of seed treated in 1954.

Answer:

7. Through the three way agreement with American Sugarcane League and the other two agencies, we sold to other farmers a portion of the treated seed. However, we are able to plant about twenty one (21) acres from 1954 treated seed plot. But out of our total amount planted, we plowed out several acres in spring of 1956 of which was bad plant cane. The cause of plant cane being bad was entirely due to a severe drought that hit us in fall of 1955. In the particular area where this treated seed had been planted, we were without rain for about 55 days.

Question:

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties

Answer

8. All varieties seemed to have a good germination in areas where we had normal rainfall during the fall. However, some of the varieties failed to come back to a full stand after being shaved in the spring of 1956. We did have two varieties to show up well after being shaved in spring of 1956; one of the leading ones was 48-103. It always held a very good stand. The next was 44-101.

   A. We did notice a mild difference of germination in varieties; however, there are many controlling

factors that could cause this difference.

Question:

9. Observations on growth and yield of cane treated in 1954.

   A. Planting ratio obtained from seed treated in 1954.
   B. Germination of seed cane, progeny of cane treated in 1954.

Answer:

9. The stand growth and yield of all varieties treated in 1954 were far superior to any of the non-treated varieties.

   A. About 9 acres to every one acre of cane. Of course, this varies some what in different varieties.

   B. Excellent in all varieties.

Question:

10. Observation on effectiveness of treatment

   A. Necessary precautions to prevent contamination
   B. Long range program to preserve seed plots of disease free seed.

Answer:

10. All varieties from treated seed whether plant cane or stubble, showed very good effect from treatment, such as size of barrel, color of cane, stand of cane, and general appearance.

   A. All tools or implements coming in direct contact with any treated seed from time taken out of treating unit up to time of lay-by should be very well sterilized before used in any of treated seed plots.

   B. We should practice the following recommendations: 1) Select the best varieties suitable for your particular field and make every effort to have a treated plot for each of these varieties; 2) in planting treated seed, be sure to select the very best land on your place in order to obtain as high a yield as possible, giving you ample amount of fall seed; 3) give treated plots best attention in cultivation, fertilization, drainage

and above all excellent supervision.

Question:

11. General discussion on field practices

    A. Dates of treatment and planting
    B. Rate of planting
    C. Depth covered
    D. Chemical weed control
    E. Winter cover crop
    F. Spring cultivation. Shaved or hoed - Chemical Weed Control

Answer:

11. A. Started treating August 29, 1955 through October 4, 1955.
    Started planting of treated seed October 4, 1955.

    B. Cane was planted two stalks with about an 8 inch lap.

    C. All treated cane was covered with about four inches of well prepared soil.

    D. Sprayed with two pounds of 2-4D in fall. In spring we sprayed after hoeing with 1-1/4 pound of Karmex to 50 gallons of water per acre.

    E. Sowed about 35 pounds of Melilotus Indica per acre.

    F. Regular cultivation as practiced in balance of cane crop. Cane was shaved and also hoed before applying 1-1/4 pounds of Karmex per acre in 50 gallons of water.

Presented by H. A. Thibodaux

Question:

1. Type of treating unit used
   A. Number of units operated - 1954-1955
   B. Source of heat
   C. Capacity per unit

Answer:

1. A unit designed and constructed by engineering department of the South Coast Corporation, after consultation with both experimental stations, composed of two compartments; each compartment holding three carts with removable shelves for storage of cane.

   A. One at Oaklawn (natural gas)
   One at Ashland (Propane)

   B. Hot Air - Two Regnor units of 200,000 BTU/hr. thermostatically controlled at each end of building. In 1955 regular window fans placed inside to help in moving air more regularly. Corners in building rounded to minimize air pockets and effect a better circulation.

   C. Two to four tons depending on condition of cane.

Question:

2. Temperature range at which cane was treated
   A. Time needed to reach effective temperature
   B. Time held at effective temperature
   C. Highest temperature reached

Answer:

2. 122° F to 138°F

   A. 2-1/2 hours to 3-1/2 hours depending on outside temperature conditions and cleanliness of cane being treated.

   B. 4-1/2 to 5-1/2 hours - Overall 8-hr. treatment from time doors were shut until opened.

   C. 138°F at Ashland and 136°F at Oaklawn.

3. **Costs of operation**
   A. Estimated cost of unit
   B. Labor cost per day or per batch
   C. Estimated cost per ton of treating (Depreciate unit at 15%)

Answer:

3. $12.00 for daily supervisory personnel.

   A. $2400.00 at Oaklawn - new unit. At Ashland no cost figures available; unit built from a building already on premises.

   B. $6.00 per batch (Supervisory)

   C. $2.00 per ton (Supervisory); $3.75 depreciation per ton: $3.00 cutting, loading and unloading in and out of unit.

Question:

4. Any specific trouble or "bugs" encountered in the treating procedure.

Answer:

4. Due to unknown reasons at times burners would go out and had to be relighted from inside. Excessive damage to eyes in handling the stalks. Having treated cane on hand during a rainy spell, we have no specific information as to how long treated seed will remain sound before deterioration.

Question:

5. Tons of cane treated, by variety - 1954-1955

ASHLAND 1955

44-101	129 Tons
36-105	36 tons
36-13	39 tons
43-47	36 tons
48-103	10 tons
47-193	36 tons
44-155	12 tons
NCo-310	9 tons

1954

44-101	138 Tons
36-105	51 tons
NCo_310	9 tons
48-103	15 tons
36-13	60 tons
43-47	24 tons
34-120	9 tons

OAKLAWN 1955

44-101	30 tons
36-105	6 tons
36-13	6 tons
44-155	15 tons
43-47	18 tons
48-103	9 tons
47-193	6 tons
NCo-310	6 tons

1954

44-101	48 tons
36-105	39 tons
29-116	6 tons
36-13	27 tons
43-47	6 tons
NCo-310	6 tons
Co-290	6 tons

Question:

6. Acres planted, with treated seed, by variety - 1954-1955

ASHLAND 1955

44-101	49.94 A.
44-155	3.46 A.
36-105	15.44 A.
36-13	12.54 A.
43-47	12.94 A.
NCo-310	3.89 A.
47-193	12.87 A.
48-103	9.67 A.

1954

44-101	81.90 A.
36-105	24.90 A.
36-13	19.60 A.
43-47	13.00 A.
NCo-310	5.00 A.
48-103	10.60 A.
34-120	5.20 A.

OAKLAWN 1955

44-101	10.33 A.
44-155	3.70 A.
36-105	1.50 A.
36-13	3.46 A.
43-47	6.00 A.
NCo-310	2.30 A.
48-103	3.00 A.
47-193	1.50 A.

1954

44-101	31.00 A.
36-105	24.20 A.
36-13	13.60 A.
43-47	3.90 A.
NCo-310	4.80 A.
Co-290	2.80 A.
29-116	2.80 A.

Question:

7. Acres planted in 1955 with progeny of seed treated in 1954

Answer:

7. ASHLAND 568.94 Acres OAKLAWN 471.68 Acres

Question:

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties.

Answer:

8. Earlier seed treated the better the germination. Some varieties appeared to be more tolerant to heat than others and, therefore, the germination was also better; for example: 44-101, NCo-310, 48-103 and 44-155.

   A. The less tolerant varieties appeared to be Co-290, 39-13, 29-116 and 47-193.

Question:

9. Observations on growth and yield of cane treated in 1954.
   A. Planting ratio obtained from seed treated in 1954
   B. Germination of seed cane, progeny of cane treated in 1954

Answer:

9. Growth of treated cane, in practically all cases where stands were uniform, was better than field run cane. This was specially true of 44-101, 36-105 and 43-47 and, to a lesser degree 48-103.

   A. Five and one-half to one (two stalks and 1/2 lapped).

   B. Good

Question:

10. Observations on effectiveness of treatment
   A. Necessary precautions to prevent contamination
   B. Long range program to preserve seed plots of disease free seed

Answer:

   A. Used separate wagons for cane to be treated and treated cane. No cane was cut in drill after planting. Use of sterilized knives on all treated planting progeny, knives including harvesters. In trucking cane slings were also sterilized.

   B. Our plan is to treat sufficient cane every year to plant a full crop two years later. Example: 1955 Heat-treated 152-Acres will plant 750-Acres in 1956 and combination of two will plant 4560, assuming a planting rate of 5 to 1.

Question:

11. General discussion on field practices
    A. Rates of treatment and planting
    B. Rate of planting
    C. Depth covered
    D. Chemical weed control
    E. Winter cover crop
    F. Spring cultivation. Shaved or hoed - Chemical Weed Control

Answer:

A. 1954 - Started September 3 - Ended October 16.
   1955 - Started August 18 - Ended October 6.

B. First progeny - 2-1/2 stalks lapped
   Direct - 1-1/2 stalks lapped

C. At planting - 1 inch and as it germinates and grows add sufficient dirt to protect plant during winter months.

D. All our direct heat-treated was planted in fallow plowed land - 4 lbs. TCA and 1 lb. 2-4,D applied after planting as recommended by Experimental Station.

E. Our observations is no cover crop on direct treated because we are desirous of working this cane as soon as possible in the spring to permit and earlier start. We find that on first progeny as all field run cane, a cover crop is good practice particularly where land has been fallow plowed.

F. As soon as weather permits in spring, cultivation is started. We do not shave direct heated cane. We hand hoe the areas that require it. Immediately following hand hoeing we follow the chemical weed control as recommended by Experimental Station, including TCA and 2-4,D.

Presented by A. M. Bartolo

Question:

1. Type of Treating unit used
   A. Number of units operated 1954-1955
   B. Source of heat
   C. Capacity per unit

One unit was operated in 1955. It was operated both on a one a day and two a day batch schedule. The unit is a tin iron building 25' long, 12' wide, with a sloping roof 7' high on one side and 9' on the other with a 10-1/4' door swinging open in the middle of the width. It is lined inside with a 1" Celotex board.

The cane is stacked on angle iron made racks mounted on dollies. This is done outside the treating unit and the racks are placed in the building by sliding them from a portable 25" angle iron made track to two 25" tracks in the building.

The source of heat is hot air which is heated by two natural gas heaters, each one having three separate heating units. The heaters are located one in the back of the building and blows through baffles directly into the building, the other is located in the front side and blows into a 12" underground tile pipe with three openings in the front, center, and back of the middle section of the building. The air from these openings is dispersed underneath the cane racks by deflectors. There is an air return system provided with dampers, and water trays in front of the heaters for humidity control.

The heaters used are from the Bryant Heater Co. of Cleveland, Ohio. Type A. Style BH, with an input heat of 255,000 BTU/Hr and output of 204,00 BTU/Hr. each.

The blowers are No. 25K Phelps Blowers of the type used in bagacillo recovery units.

The cane capacity of the building is four racks, two per track, or approximately 4 tons of cane per batch.

Actually an average of 3.1 tons of cane per batch were treated in 1954 and 3.79 in 1955.

Question:

2. Temperature range at which cane was treated
   A. Time needed to reach effective temperature
   B. Time held at effective temperature
   C. Highest temperature reached

The temperature range at which the cane was held was anywhere from 129°F to 134°F. Momentarily, however, higher air temperatures were observed in the unit.

In talking about time used to reach effective temperature, I mean that the air temperature throughout the whole unit is at least 129°F. It usually took one hour longer for the temperature to reach the air temperature level.

A. Time held to reach effective temperature

In 1953	5 to 6 hours
In 1954	4 hours
In 1955	2 hours

B. Time held at effective temperature

In 1953	3 hours
In 1954	3 hours
In 1955	6 hours

C We do not know if the temperature in the cane ever exceeded 132°F in any particular spot in the unit. Every time the temperature was checked in the cane it was never found to be over 131°F. Air temperatures were noticed to go at times as high as 140°F at the top of the building. These were very momentary and were corrected either by thermostatic or manual controlling. Such temperatures were noticed all three years with no apparent ill effects to stands yields. It is, however, to be noted here that the longer treating time in 1955 resulted in overtreatment giving only a 30 to 40% stands yield.

Question:

3. Cost of operation
   A. Estimated cost of the unit
   B. Labor cost per day or per batch
   C. Estimated cost per ton of treating (Depreciate unit at 15%)

A. This is hard question to answer as the heaters were available, old boiler tubes were used for the frame of the building, and other available material was used.
A good guess would be that the cost was about $2,000.00, but would have been higher if we would have had to buy the heaters and other materials used.

B. The labor cost was about $21.00 per batch

C. The estimated cost per ton of treating

In 1953	about	\$9.80	
In 1954	about	\$9.57	≠ gas costs
In 1955	about	\$8.33	

Question:

4. Any specific troubles or "bugs" encountered in the treating procedure

There are several "bugs" that are to be found in the treatment procedure, most of which are interdependent. The factors causing such troubles are characteristic to individual treatment units, but the following are probably very widespread.

1) Void Air space

2) Hot or cold spots due to improper air distribution at inlets and recirculation outlets

3) Insufficient air recirculation. (Times the volume of air in the chamber is changed per minute)

4) The manner of cane distribution

The correction of such trouble causing factors would have to be suited to individual needs. It can be said generally that to approach an ideal system the following will be true:

1) The smaller the capacity of a unit the better as long as there is enough room for air circulation through the cane but no void space either above, below or on the sides of the cane stacks.

2) A uniform method for air spread at the inlet and of air removal for recirculation.

3) As much air recirculation as possible, because theoretically if there is an infinite amount of air recirculated then the inlet temperature will equal the outlet temperature and the temperature of the cane, making such a system very easy to control.

Question:

5. Tons of cane treated by variety 1954-1955

For 1954

Variety	Tons
29-120	14.630
36-105	28.275
36-13	17.490
44-101	27.180
44-155	8.880
NCO-310	7.790
50-11	2.610
Mixed	1.850
	108.705

For 1955

In 1955 all of our treated cane were progenies of previously treated cane, and will be indicated as stubble if it was treated in 1953 and plant if treated in 1954.

Variety	Tons	Variety	Tons
29-120 Plant	21.270	44-155 Stubble	9.230
36-105 Stubble	17.910	NCO-310 Stubble	9.280
36-13 Stubble	12.110	48-103 Stubble	9.100
44-101 Stubble	**27.100**		

Total 106.000 Tons

Question:

6. Acres planted, with treated seed, by variety 1954-1955

For 1954

Variety	Acres planted
29-120	9.20
36-105	18.27
36-13	8.00
44-101	15.36
44-155	5.20
NCO-310	4.18
	60.21

For 1955

Variety	Acres planted
29-120	7.63
36-105	8.98
36-13	5.57
44-101	14.81
44-155	4.87
48-103	6.70
NCO-310	4.73
	53.29

Question:

7. Acres planted in 1955 with progeny of seed treated in 1954

The answer to this question is about 2500 acres of progeny and heat treated cane of which 1400 acres are at the Houma division.

Question:

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties

Germination on all treated seed was excellent for the years 1953 and 1954. Probably variety 36-105 is the one that responded best to treatment.

Question:

9. Observation of growth and yield of cane treated in 1954
   A. Planting ratio obtained from seed treated in 1954
   B. Germination of seed cane, progeny of cane treated in 1954

   A. About 2447 acres were planted from 60.2 acres of seed treated in 1954, for planting ratio of 40.6

   B. Germination of seed was excellent except for 1955 because the cane was overtreated. Germination of cane progeny (1954) is excellent.

Question:

10. Observations on effectiveness of treatment
    A. Necessary precautions to prevent contamination
    B. Long range program to preserve seed plots of disease free seed

    A. To prevent contamination all mechanical field equipment is sterilized. There is a possibility of contamination through the roots during cultivation.

    B. The long range program to prevent reoccurence of the disease in seed plots is to treat the progeny of previously treated cane so as to keep all of the seed cane at a maximum of two years away from the treatment unit. This is excluding 1955 because our program was offset by the overtreatment of last year's seed cane.

Question:

11. General discussion on field practices
    A. Dates of treatment and planting
    B. Rate of planting
    C. Depth covered
    D. Chemical weed control
    E. Winter crop cover
    F. Spring cultivation. Shaved or hoed - Chemical weed control

A. The cane treated was usually planted the day following the treatment with permitting weather conditions. Cane treated on Saturday was planted the following Monday.

B. In 1954 .60 acres per ton of treated seed
   In 1955 .52 acres per ton of treated seed

C. Depth covered - 2-1/2"

D. 2-4D 1-1/4# of the sodium salt per acre for each treatment. Two or three treatments.

E. No winter crop cover

F. Regular cultivation. Hoed. 2-4D as in section D.

HEAT TREATING OF SEED CANE FOR CONTROL OF RATOON STUNTING DISEASE

Presented by Paul J. Cancienne

Question:

1. Type of treating unit used
   A. Number of units operated 1954-55
   B. Source of heat
   C. Capacity per unit

Answer:

1. Unit No. 2, hot air.

   A. 1954 - None
      1955 - Two

   B. Electric

   C. 1.2 tons

Question:

2. Temperature range at which cane was treated
   A. Time needed to reach effective temperature
   B. Time held at effective temperature
   C. Highest temperature reached

Answer:

2.
   A. Approximately 5 hours

   B. Three hours

   C. 59°C Ingoing air

Question:

3. Cost of operation
   A. Estimated cost of unit
   B. Labor cost per day or per batch
   C. Estimated cost per ton of treating (Depreciate unit at 15%)

Answer:

3.

A. Unit No. 2 - $ 863.40

Timerstat - 25.00

2 Racks - 272.80
$1161.20

B. $25.65/day

C. 3.79 Dep. on unit - (Not a true value because of the short time we operated)

1.09 Tractor & wagons)
5,13 Labor) Ideal conditions
3.33 Electricity)
13.34/ton)

Question:

4. Any specific trouble or "bugs" encountered in the treating procedure.

Answer:

4. a. Heaver guide rails in the bottom
b. Too slow in reaching optimum temperature

Question:

5. Tons of cane treated, by variety - 1954-1955

Answer:

5. 36-105 - - - - - - - - 28.24 tons
44-101 - - - - - - - - 25.95 tons
48-103 - - - - - - - - 7.06
61.25 tons

Question:

6. Acres planted, with treated seed, by variety - 1954-1955

Answer:

6. 1954 - None
1955 - 36-105 - - - - - 9.2 ac.
44-101 - - - - - 7.3 ac.
48-103 - - - - - 2.3 ac.
18.8 ac.

Question:

7. Acres planted in 1955 with progeny of seed treated in 1954

Answer:

7. None

Question:

8. Observations on germination of treated seed
   A. Any difference noted in germination of different varieties.

Answer:

Best stand in 44-101
48-103 very poor in spots

Question:

9. Observations on growth and yield of cane treated in 1954
   A. Planting ratio obtained from seed treated in 1954
   B. Germination of seed cane, progeny of cane treated in 1954

Answer:

9. None

Question:

10. Observations on effectiveness of treatment
    A. Necessary precautions to prevent contamination
    B. Long range program to preserve seed plots of disease free seed

Answer:

10. Disinfected all tools coming in contact with treated cane, even planted from tray that cane was treated on.

Question:

11. General discussion on field practices
    A. Dates of treatment and planting
    B. Rate of planting
    C. Depth covered
    D. Chemical Weed control
    E. Winter cover crop
    F. Spring cultivation. Shaved or hoed - Chemical Weed Control

Answer:

11. A. Sep. 15 to October 13 but was often stopped by wet weather

B. Freshly treated approximately 3 tons

C. 4 inches

D. 2,4-D and T.C.A. in fall, after shaving and again after applying fertilizer. Rogued once.

E. None

F. Shaved

SUGARCANE PLANTER PROGRESS REPORT FOR 1955

By R. M. Ramp, Agricultural Engineer, Farm Machinery Section, Agricultural Engineering Branch, Agricultural Research Service, U. S. Department of Agriculture.

Development work on a sugarcane planter for Louisiana conditions was recommended by the Farm Machinery Research Advisory Committee of the American Sugar Cane League at their annual meeting on February 16, 1954. During that year a one-row pull-type planter was constructed and field tested. Results were reported to the Advisory Committee on February 24, 1955 and to the American Society of Sugar Cane Technologists on March 1, 1955.

The planting machine program for 1955 was formulated by the Advisory Committee and details worked out with a sub-committee composed of Messrs. Walter Godchaux, Roland Toups, and J. J. Munson. The following service requirements for a sugarcane planter were approved:

1. The planter shall be tractor-mounted to facilitate planting the ends of the rows and turning.

2. The planter seed hoppers shall have a capacity of 2 to 3 tons.

3. Rows are to be partially opened in a separate operation to reduce the planter power requirements.

4. The planter shall be capable of handling full length seed canes (maximum of 72 inches) with adhering trash and permitting the canes to be cut in half.

5. Seed canes are to be transferred from the transport cart to the planter with a winch truck or dragline in 1- to 1 1/2-ton sling loads.

6. The planter shall be capable of completing the planting furrow to the desire depth and width.

7. The planter shall be capable of partially covering the seed canes.

8. The planter shall be of two-row design capable of planting one row on each side of the tractor at the same time.

9. The row spacing shall be standardized at 5 feet 10 inches.

10. The rate of planting and seed pattern shall be adjustable to secure a uniform distribution of seed.

The furrows were opened by a tractor equipped with middlebreakers and gauge wheels mounted on the rear tool bar. The gauge wheels were operated in the middles to control the depth of opening in relation to the middles. The tractor straddled the center row while operating a planting furrow on each side row. It was necessary to operate the planter in the matching rows to properly place the seed cane in respect to the seed bed.

The mounting unit for the planter consisted of a MV cane tractor equipped with a low-low gear (1.70 mph engine speed) to obtain the required drawbar pull in relation to the forward speed. Completion of the planting furrow to the desired depth was accomplished by a furrow opener attached to the front of the planting trough. A rubber-tired gauge wheel was attached to this unit to control the depth. The construction details of the furrow opening and planting mechanism of the experimental sugarcane planter are illustrated in Figure 1. The openers were normally set shallow with the final depth of seed placement being controlled by the position of the planter furrow opener (1). During the planting operations the weight of the furrow opening assemblies was carried by the gauge tire (2), thus allowing the position of the furrow openers to maintain a constant vertical relation with respect to the row completely independent of the tractor. The furrow opening assemblies were attached to the main frame of the planter through a hydraulically operated lift linkage (3) for raising the unit during turning or transport. The planter trough (4) consisted of two sides with flared extensions on the upper edge for guiding the canes into the furrow. The sides of the troughs prevented loose soil from falling into the furrow before the canes were placed. The rear end of the trough was open and supported by the rear tool bar (5). Tool bar brackets were provided for mounting the covering disks and packers wheels. The final covering and firming of the bed were done in a separate operation.

The seed cane was carried on the planter in two hoppers (6), 4x4x10 feet, located on each side of the tractor engine. One to 1 1/2-ton bundles of seed cane were loaded lengthwise in the hoppers from the transport cart by means of a winch truck, each hopper being loaded from its respective side with the cane butts extended toward the rear. Completely loaded, the planter had a capacity of 2 to 3 tons of seed cane.

Each seed feeding mechanism illustrated in Figure 2 was equipped with a feed chute (7), feed roll (8), and saw (9). The canes were dropped by hand lengthwise into the feed chute (7), either one or two at a time. Each feed roll was equipped with one row of feed fingers (10) for feeding the seed cane into the planter trough. The right hand feed roll was rotated anti-clockwise with the feed fingers passing upward through slots in the bottom of the feed chute (7). As the fingers pass upward they lift the canes from the bottom of the chute and carry them through approximately half a revolution before the canes are dropped free into the planting furrow. Stripping bars (11) were provided next to each feed finger to assist in the positive dropping of the cane from the rolls into the planting trough.

Power-driven circular saws (9) were located at the mid-point of each feed chute to cut the canes as they were moved past the saw by the fingers. The cutting operation was done to assist in the alignment of the cane in the planting furrow. The exact point at which the individual canes were cut depended upon their position in the feed hopper relative to the saw. Straight canes were planted without cutting by removing the saw blades.

The desired rate of planting or lines of cane per row foot depended upon the length of the seed cane and the speed of the feed rolls in relation to the ground speed. With a given rate of planting the feed roll speed was decreased in proportion to the increase in seed length. For example, doubling the length of the seed canes reduced the feed roll speed one-half or permitted the ground speed to be doubled. In all the field test the feed rate was set on the basis of the desired rate for a given seed length. When the seed canes were longer than the assumed length, the rate of planting was increased in direct proportion to the additional length.

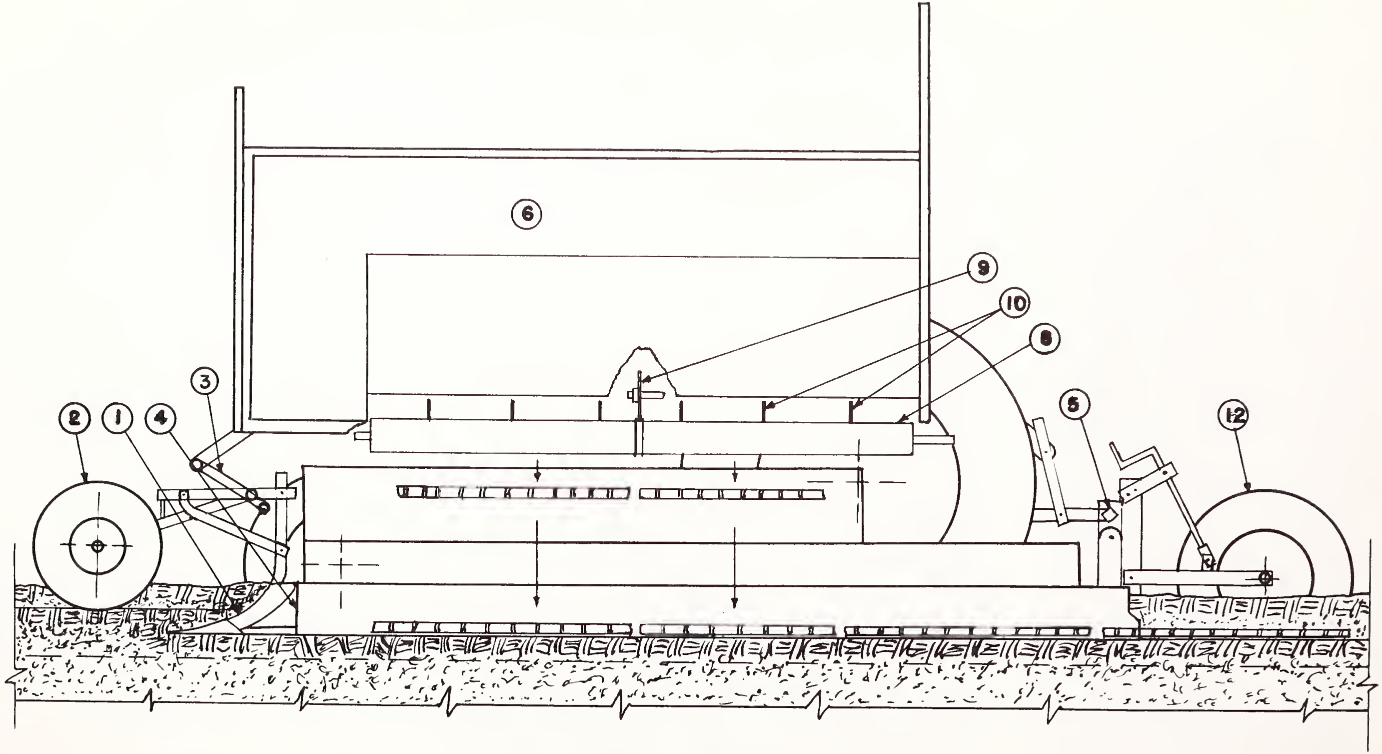


Figure 10. USDA experimental two-row tractor-mounted sugarcane planter illustrating construction details. (1) Planter furrow opener, (2) Gauge tire, (3) Lift linkage for furrow opener, (4) Planter trough, (5) Rear tool bar, (6) Seed hopper, (8) Feed roll, (9) Saw, (10) Feed finger, (12) Rear tool bar gauge tire.

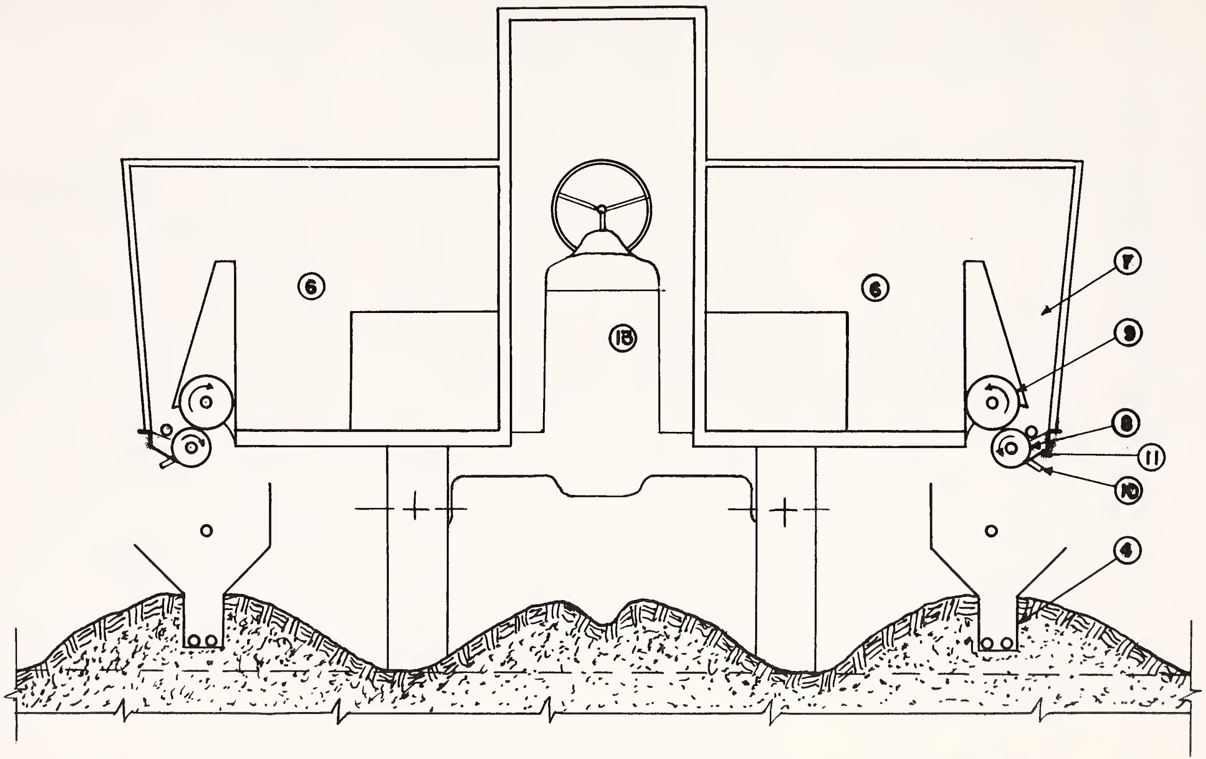


Figure 11. Cross-section view of experimental sugarcane planter illustrating seed cane movement. (4) Planter trough, (6) Seed hopper, (7) Feed chute, (8) Feed roll, (9) Saw, (10) Feed finger, (11) Stripping bars, (13) High clearance cane tractor.

Field testing of the experimental two-row sugarcane planter was conducted in cooperation with Godchaux Sugars, Raceland, La., from September 12 through 28. A summary of varieties, fields, and acreage planted is given in table 1.

Table 1. Cane planted with experimental planter, Raceland, La., Sept. 12-28, 1955.

Variety	Cut	Acres
C.P. 44/101	101 w	1.64
	196 g	1.64
	103 e	1.63
	103 1	1.16
	103 m	1.04
	103 n	1.14
	103 z	.87
	104 aa	.55
	104 e	1.08
	101 1 (treated)	.79
	104 m	.79
	104.n	.71
	104 z	.90
Total		13.94
C.P. 36/105	3 d	1.50
	112 b (treated)	1.24
	61 a	1.50
Total		4.24
C.P. 44/155	61 a	1.00
	20 b	2.34
Total		3.34
Total, all varieties		21.52

When first put into operation, the planter was equipped with press wheels and covering disks, however after a short period of operation they were removed to permit visual inspection of the cane before covering. The drives for the saw were too weak for satisfactory operation without occasionally stalling. Since the canes were sufficiently straight for feeding without cutting, the saw blades were removed to reduce choking. The long leaves attached to the seed cane frequently retarded the prompt dropping of the seed cane pieces, thus causing gaps and uneven planting. Stripper bars located along side the lifting fingers materially reduced the amount of delays from dropping but did not completely correct the difficulty. It was found that the satisfactory operation of the feed

roll depended to a large extent upon correct hand feeding. If a cane was not dropped flat, the lift fingers did not engage the entire length of the cane at the same time and one end of the cane was carried around the cylinder ahead of the opposite end thus causing the cane to be retarded and broken. Two feeders were used on each feed hopper to increase the ground speed, however it was soon found that there was not sufficient space on the planter for both feeders to supply the necessary seed cane.

Bundles of cane with tops and butts mixed made it difficult for the feeders to separate the canes. When the canes were placed in an inclined position trash accumulated on the bottom of the hopper, whereas when the canes were placed flat in the hopper the trash accumulated on top of the seed supply making it difficult to select the canes. In both methods of loading it was found necessary to completely empty the hopper before reloading because of the large amount of trash and soil that accumulated on the hopper floor.

Time studies of the field operation showed that there was a wide variation in the loading and planting times for a given load. Time studies are summarized in table 2. The time required to load the planter varied from a minimum of 7 to a maximum of 65 minutes with an average of 22 minutes. It was observed that the following factors contributed to the wide variation of time required for loading: (1) Bundles of cane were not in position for planter when the planting operation was completed; (2) Bundles were not turned properly for placing the tops forward on the planter; (3) Bundles often too large for hopper, necessitating hand shifting of the canes to clear the hopper chute; and (4) It was often necessary to turn the planter around to load both hoppers. The variation in planting time for individual loads was caused by the necessity of completely emptying the hopper between refills and by chokes at the feed rolls or planting trough. Actual time loss, however was minor. The main objections to chokes were the resulting variation in planting rate. During the field trial period two helpers followed the planter to position the cane at the quarter drains and to fill in gaps in addition to removing chokes.

Table 2. Time studies on operation of experimental sugarcane planter.

Date	Moving or time out		Planting		Loading	
	No. periods	Time (Min.)	No. periods	Time (Min.)	No. periods	Time (Min.)
Sept. 22	1	80	7	310	5	140
23	1	90	7	277	6	103
26			7	294	6	207
27			8	359	7	108
28	1	55	7	350	5	80
Totals	3	255	36	1,590	29	648
Total time, percent	9.13		64.55		26.30	
Average time for each operation, minutes	75		44		22	
Minimum time for each operation, minutes	55		11		7	
Maximum time for each operation, minutes	90		88		65	

Observations and conclusions on the operation of the two-row sugarcane planter are as follows:

1. The combination of opening and planting provides a more accurate control of the depth of planting than can be obtained with the present planting method. This is specially noticeable on heavy soil where there are many clods.

2. The seed hoppers were too small and did not have sufficient capacity to take care of the wide variation in bundle sizes.

3. Canes should not be mixed in a bundle as to direction of the tops.

4. The seed cane should be placed with the tops forward and the butts toward the rear to reduce choking.

5. The excessive weight on the front wheels of the planter make it difficult to turn short onto the headlands.

6. The adhering trash on the seed canes frequently retarded the dropping of the canes, thus causing an eneven rate of planting and gaps that had to be filled by hand.

7. A capacity of 4 acres per 9-hour day was obtained with two feeders.

8. A summary of the time studies showed: time out, moving, etc. - 9 percent; planting - 65 percent; loading - 26 percent.

9. At least one helper or inspector will be required on a planting machine until the feed mechanism has been sufficiently improved to eliminate gaps.

NEW METHOD OF SAMPLING AND
TRASH TESTING AS IS PRACTICED AT RACELAND FACTORY
GODCHAUX SUGARS, INC.

Ridley J. LeBlanc

We receive approximately 3,900-4,000 tons cane daily. Of this amount 3,100-3,200 tons is trucked. The remainder is by rail plus our local administration cane which is delivered to the factory by tractor-trailer. Our method of sampling the cane for trash, sucrose etc. is as follows;

As the cane is received, whether it be Individual grower or Administration cane, it is weighed on either of two 50 ft. platform scales, with the weight recorded under the Shipper's name on scale-house record book. The weigher then gives this load of Cane an identification number and records this number on sample tag that he passes on to Cane Inspector. This is the only means of identifying either Cane or sample from scale on through process of sampling and cleaning. The inspector inspects each load of cane from both sides and back of Trailer, and attempts to select a bundle representative of the load. He directs this bundle to be unloaded onto a conventional cane cart drawn by a conventional tractor. The tag is given to the Tractor driver who in turn passes it on to the Foreman or clerk of the Trash testing crew. The sample bundle is removed from cart and placed on Feeder-table handling all sample cane. When this sample bundle reaches the correct sampling location, the bundle now being opened, a sample weighing between 60 and 75 lbs. is taken with a Mechanical Grab, transferred to a previously tared galvanized pan and weighed on a Dial scale calibrated in lbs. and ozs. The weight of the pan is deducted and the weight of gross cane recorded on sample tag. The cane is now dumped from the Pan onto a table just ahead of the cleaners, the tag given the Foreman or Clerk again, and the cane cleaned. The clean cane is placed in another previously tare-weighed pan, weighed on a second Dial scale, and the net weight of cane recorded on sample tag. The tag is retained by the Clerk and the Cane thrown onto carrier feeding mills. From the results recorded on sample-tag, the Clerk calculates the weight and percentage of Trash and files the tag temporarily. At the end of the hauling day, a simple average of the percentage of Trash is determined and recorded on the last tag of the group of tags for each grower which accompanies the composited sucrose sample to

the Laboratory. The simple average is then copied on the Laboratory Individual Test Sheets, and the tag filed permanently. While a simple average of the entire number of tests for each Grower is used, a portion of each trash sampled cane is collected and composited. This sample is sent to the laboratory at the end of the Grower's hauling day accompanied by all sample tags collected during the day of each Grower. When the sucrose sample is taken, which is merely a few stalks from the Pan handling gross cane prior to weighing of first Dial scale, the stalks are placed in a standing position and held together by a piece of light chain with snap fastener with numbered metal tag attached. This, we found, was an improvement over the bin method of temporarily storing sample cane. The first sample collected for each Grower daily is given the identification number previously referred to, while each succeeding sample for each grower for any one day carries the index number followed with a letter; thus,(1) (1a) (1b) (1c), etc. The letters denoting whether it is the second, third or fourth trash sample collected etc. While sampling and Trash testing goes on all during the hauling day, the samples are analyzed for Brix, Sucrose and Purity beginning at the end of each Grower's hauling day. We have two people doing juice analyses who work from 4:00 P.M. until 12:00 P.M. Beginning at 4:00 P.M. the samples are ground on a 10" x 15" Hydraulic Pressure three roll mill, the juice collected and analyzed. The sample number, the percentage of Trash taken from Sample-tag and results are recorded on Daily Individual Test Sheets, and summed or averaged at end of day.

The change from sampling by hand to sampling mechanically has changed the results obtained to a more uniform figure. We actually experience fewer of the very high and low tests, we used to obtain, making the general average more representative than formerly. We have been using the mechanical grab method of sampling now for two grinding seasons, and apart from more economical operation if nothing else is gained, it makes the rather unreliable method of Testing appear more business like, to say the least. The average Trash determination the last year of hand-sampling was 3.95% as compared with mechanical-grab sampling the past two years of 7.37 and 5.19%.

While we feel the above method is fairer and more efficient, we have found also that cost of operation has been reduced over the former method. In the old method we employed (12) men as compared to (9) men in the new method. The method is simple and methodical and on various occasions the Growers have either actually run their own samples or have closely supervised operations to their satisfaction.

Considering the reduced cost of operation we have experienced increased efficiency as well as increased rapidity of handling a large number of samples. We sincerely recommend the above method of Sampling and Trash Testing to all concerned.

SOME SOIL AND WATER CONSERVATION PROBLEMS AND THE ADVANTAGES OF A SOD-CROP ROTATION ON SUGAR CANE LANDS

By R. J. Jeansonne, Soil Conservation Service.

Soil and water conservation has come to mean different things to people in different sections on the country, dependent upon the problems involved, and the kind of treatment needed. The objective however, is the same, regardless of where we are.

The basic objective in Soil and Water Conservation of the Department of Agriculture and that of Soil Conservation Districts is the use of each acre of agricultural land within its capabilities and the treatment of each acre of agricultural land in accordance with its needs for protection and improvement.

In applying this objective to the alluvial land in the sugar belt of Louisiana we find that a large majority of the land, outside those areas subject to overflow, can be used permanently for the production of row crops or pasture, if given the right combination of conservation treatment.

The treatment needs on this land depend upon the kind of soil and the kind of treatment it has received since it was cleared of timber. Due to the nearly level topography and high rainfall of the area most of it required drainage in some degreee in order to use it profitably for the production of crops.

For many years after the land was cleared, drainage is about all that was considered necessary to farm it profitably. The soils being of alluvial deposits from the best top soil in the watershed of the Mississippi River, were rich in minerals and organic matter. They were in good physical condition allowing water and air to enter well and plant roots could penetrate deep to get the food and water needed. Good crops were grown even without the use of commercial fertilizer.

After years of use, however, for the production of cultivated crops, we find that our soil on many fields is not as rich in organic matter and minerals. The physical condition is not as good as it was when the land was first cleared. The soil tends to run together more now restricting plant root penetration and the rate of water intake into the soil. We are troubled more with water

in heavy rains and must provide better drainage to take care of the added runoff that does not get into the soil. We are affected more by droughts since we are getting less water into the soil, and that which does enter is not as readily available to the plants because root development is restricted.

In filtration checks made recently by Soil Conservation Service personnel show the water intake rate to be as low as .2 of an inch per hour on some of our medium textured soil in poor physical condition. At this rate it would take 10 hours of rain to get 2 inches of water into the ground. Under those conditions a 2 inch rain will not necessarily put 2 inches of water into the ground. It depends on how fast it fell.

The average medium textured soil under cultivation in the sugar cane area that is in good condition will take water at the rate of about one-half inch per hour. Freshly plowed ground of course will take water at a rate much faster than this until the area broken is saturated. After that, however, the rate will be governed by the physical condition of the soil below the plowed depth.

The available water hold capacity of the average medium textured soil in this area is about 2 inches/foot of depth. Sugar cane roots will penetrate about 2 ft. deep on this soil when it is in good physical condition. The average sugarcane crop at its peak consumptive period will use about 2 inches of water every 7-1/2 days.

One can readily see from this that sugarcane growing on land in good condition where roots can penetrate 2 ft. deep there would be enough moisture to carry the crop 15 days after a rain that provided enough water to fill the soil to capacity. On the other hand, sugarcane growing on land in poor physical condition where roots penetrated only a foot deep there would be moisture available to carry the crop only seven and one-half days.

Not only is it important to maintain our soil in good physical condition from the standpoint of moisture, it also is important from the standpoint of plant food. Plant roots penetrating two feet deep have twice as much soil area from which they can get their food than plant roots that penetrate only a foot deep.

How then can we maintain our soil in good physical condition? To get the answer to this we should examine the cause for land becoming in poor physical condition. When we look back we find that our soil was in good condition when in its virgin state under forest. When the land was cleared and cultivated organic matter depleted rapidly. Continuous cultivation not only helped

to speed up depletion of organic matter but frequent travel of farm equipment over the fields also packed the land, both leading to a poorer soil condition.

The logical treatment then to improve land that has become in poor condition as a result of continuous cultivation would be to limit cultivation and return more organic matter to the soil. Past experience has shown that the best way to accomplish this is to include a grass and legume sod in the rotation. While under sod, organic matter accumulates and equipment traffic is reduced.

Soil Conservation District cooperators are beginning to recognize more and more the advantages of a sod-crop rotation to improve and maintain soil productivity. A number of sugarcane farmers have started such a rotation in the last few years. It affords an excellent opportunity for use of land that has been diverted from row crops as a result of acreage allotments.

Grass and legume sods to be most effective should contain deep rooted plants and must not be overgrazed. Since it is the roots of plants that aid most in improving the physical condition of the soil, it is important that plants be selected that have a deep root characteristics and to manage them in such a way that their roots will be allowed to develop well and penetrate deep.

In planning rotations of cultivated crops with sod or pasture it is important to determine the length of rotation to be followed and the division of fields to be made before beginning the rotation in order to prevent complications in the system in the future. The farm or part of farm to be included in the rotation should be divided into fields equaling the number of years in the rotation. This would allow the planning of a system whereby one field would go from row crops to pasture each year while another field would go from pasture to row crops each year. The field boundaries should be so arranged that the soil in any given field will be as near as practical, of the same land capability class. This is important in order to permit the use of pasture plants and crop varieties that are best suited to the different kinds of land. The length of rotation to be followed should be considered in light of intensity of treatment needed to improve and maintain the fertility and condition of the soil over a long period of time. A rotation of 3 to 4 years pasture followed by 3 to 4 years of cultivated crops, which devotes the land to sod crops half the time and to cultivated crops half the time, would probably be the most desirable under our average conditions.

Sod crops or pasture to be very effective in improving soil conditions and in order to justify the

cost of establishment should remain on the land at least 3 years. Under our climatic conditions most of the organic matter accumulated under 3 to 4 years sod will be used up after 3 to 4 years cultivation. Some of our more fertile land in good condition may only need sod crops 1/4 to 1/3 of the time to maintain production. Annual cover crops may be used in the rotation between sod crops. Sod crops are favored over annual cover crops to improve and maintain soil productivity because it gives a more complete cover and furnishes more roots to open the soil, it provides for the use of deep rooted perennials to obtain better root penetration, reduces equipment traffic and permits grazing to reduce Johnson grass infestation. Where the land is in good condition, however, a good job of soil maintenance can be done through the use of cover crops when combined with the use of available crop residue for soil improvement.

Grass and legume sod rotation should not be regarded as a cure-all for all soil problems. It, like other conservation practices, is most effective when used in combination with other needed practices. Drainage is needed on most of our land in the sugarcane area to remove excess water during periods of high rainfall. To obtain adequate drainage on some fields, particularly on very heavy soils, it may be necessary to level or crown the land to eliminate pockets or low places between ditches where water stands. Where plow or traffic pans are present they should be broken by deep plowing or subsoiling and then treated vegetatively. Fertilizer should be applied in accordance with needs and all available crop residue should be returned to the soil. Irrigation may be the answer to further increase crop yields if additional water is needed after a thorough job of soil conditioning has been done.

Crop varieties, weed control, insect and disease control, cultivation, and good over-all farm management, all play an important part in crop production. Only by combining all these with a thorough job of soil and water conservation can we expect to obtain maximum results.

EFFICIENT USE OF SUGAR CANE SPRAYERS

by

Joseph L. Smilie, Assistant Agricultural Engineer
Agricultural Extension Service, Louisiana State University

Efficient use of sugar cane sprayers primarily includes proper application techniques and maintenance. Dollar for dollar, investment in these two factors exceeds any dividends received from chemicals when applied improperly. No matter how good a chemical is, it has to be applied properly for greatest returns.

In the future, we can look forward to chemicals that will reduce cost, and increase efficiency. At the same time, tolerance of sugar cane to these chemicals will most likely be much closer than with our present chemicals. This factor alone - tolerance of sugar cane to chemicals - requires accurate calibration of sprayers and a precise technique of application. Efficiency in a chemical weed control program is dependent on the proper use of sprayers.

Application Technique

Fields observations during the last two years have revealed that poor application of chemicals are frequent, and consequently, dissatisfaction results.

Proper application begins with a clean and rust free sprayer. It should be equipped with screens on both suction and discharge sides of pumps as well as nozzle screen. To continue proper application, the sprayer must remain free of foreign materials.

Calibration:

Calibration is not a "guessing" operation. It should be done as accurately as possible since it determines the amount of chemicals discharged per acre. Calibration consists of the following steps:

1. Select proper nozzle size. Nozzles discharging one to two tenths gallons per minute at 40 pounds pressure with an 80° fan are satisfactory. USE SAME SIZE NOZZLES ON ALL OUTLETS.

2. Fill sprayer tank with water which is free of trash.

3. Operate sprayer at a satisfactory spraying speed over a given number of acres at about 40 pounds pressure.

4. Determine the gallons of water used and divide by the number of acres covered. This will give the number of gallons to be applied per acre. **Twelve** gallons per acre on a 24" to 30" band is the minimum requirement for sugar cane weed control.

5. Divide the gallons of water in a tank by the **gallons** applied per acre to determine the acres covered per tank.

6. Add chemicals as recommended by the Experiment Station to cover the acres to be sprayed per tank. Then mix chemicals thoroughly before spraying. Pre-mixing of the chemicals before putting them into the tank is a good policy.

7. The pressure and speed used in Step 3 should be maintained throughout the spraying operation keeping the calibration accurate. Keep a close check on acres covered with each tank of solution so that over or under application and dissatisfaction will not be the final results.

Nozzle Selection:

Brass nozzles which produce a flat, fan-shaped spray are considered best because they give the most uniform coverage and the strongest drive. Nozzles require a minimum of about 20 pounds pressure before they will fan out properly. Increased pressure results in greater discharge, a wider fan, and finer droplets. Decreased **pressure** has the opposite effect--smaller discharge, a narrower fan and bigger droplets. To keep drift at a minimum, use spraying pressures between 25 to 45 pounds. By using wide angle nozzles (95°) the boom can be lowered (more than with an 80° nozzle) to cut down drift during windy weather applications.

Applications:

Three nozzles per row are generally used--one nozzle centered over the row and the other two about 15" to each side as shown in Figure I. The center nozzle is adjusted in height so that the fan completely covers the top of the off-bar. The two outside nozzles are so adjusted that the inner edges of the spray pattern lap in

the center of the drill. This arrangement gives an even distribution of the chemicals on the off-bar section with a slightly heavier concentration in the center. Furthermore, the sides of the off-bar are sprayed thereby killing the Johnson grass rhizomes that have been sheared in the off-barring operation.

The three-nozzle arrangement should be centered over the row; otherwise, a portion of the chemicals will be deposited on only one shoulder. The portion of the row sprayed outside of a 24" - 30" band centered on the drill is a complete waste. As the center of the nozzle arrangements moves from the center of the row, the efficiency is progressively lowered. This factor is very important when multirow sprayers are used on land worked with one-row equipment. In this case, rows should be laid out as uniformly as possible. In addition, with three-row equipment, the outside nozzle groups should be readily adjustable by the operator while spraying. The nozzle group should have individual shutoffs to facilitate spraying odd rows in a cut, or using the sprayer for spot treatments.

The two outer nozzle can be adjusted to spray a 36" band for all treatment of plant cane and readjusted to spray a 24" drill.

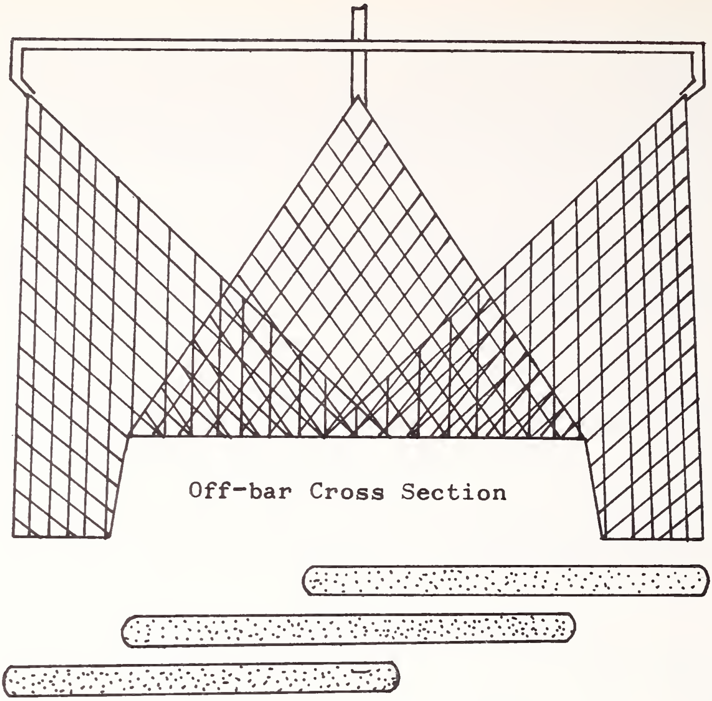
The sprayer boom should be adjustable in height. In using chemicals where it is necessary to spray grass and weed foliage, the boom should be raised in height corresponding to the average height of grasses and weeds treated. Additional boom height is needed in layby application where both the drill and middle are sprayed.

Sprayer Maintenance

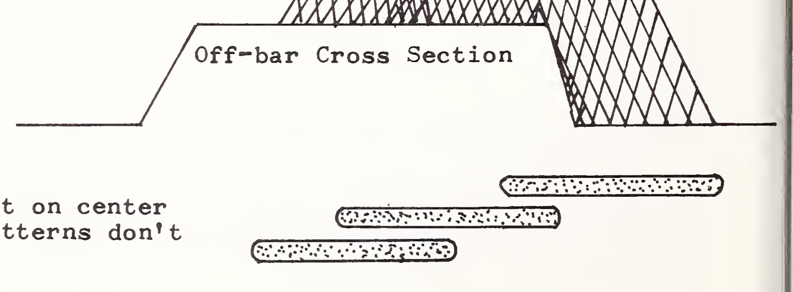
The Sprayer Tank:

Most sugar cane sprayer tanks are made of steel. Some of these tanks are galvanized on the inside while others are left bare. Bare tanks will rust but may be overcome by coating the tanks with a rust-preventive oil or used cylinder oil. This is done when the tank will not be in use for an extended period of time. Even with galvanized tanks, it is a good practice after cleaning to coat the inside of the tank with oil, especially all the welded joints. Where corrosive sprays are used, it is also desirable to completely paint the outside of the sprayer.

The water should be filtered to eliminate trash and sand. If the tank is clean, free of rust and foreign matter and maintained in this manner, nozzle stoppage will be reduced to a minimum.



Correct Nozzle Setting



Nozzles aren't on center of row and patterns don't overlap.

Incorrect Nozzle Setting

The Pump:

A dependable pump is required in every spraying system. Nylon rollers and diaphragm type pumps with rust resistant bodies are generally recommended over bronze gear pumps because of their better ability to withstand wear and corrosion. Centrifugal type pumps must be operated at high speeds and are not recommended for general row crop spraying. Pump capacity should be from five to eight gallons per minute in order to have enough volume returned to the tank for proper agitation. By-pass agitation is usually adequate for the chemicals now recommended in sugar cane for weed and grass control. Auxiliary engines, where they are used, should have sufficient power to operate the pump at its maximum capacity. If the pump is to be driven from the power-take-off, then the power-take-off should be "live" so that the pump's RPM will be maintained when the engine is clutched to shift gears or the transmission is out of gear. For off-season storage, the pump should be checked for leaky packings, drained and flushed with a light oil. It is important that water be drained from the pump because the housing may be cracked by a freeze during the winter.

Agitation:

Agitation requirements for the chemicals currently used on sugar cane is furnished by the by-pass from the pump. This is known as hydraulic agitation. If wettable powders are used for ditch bank spraying, then mechanical agitators are a must.

Valves and Fittings:

Pressure gauges, relief valves, and hoses should be cleaned after each season and replaced if necessary. Calibrating a sprayer with a faulty by-pass valve and pressure gauge is time consuming and often very erratic. Pinched hoses can cut off the flow to nozzles and can result in nozzle stoppage where interlining of hoses flake off.

Nozzles:

The distribution of the spray material is dependent on the nozzles. Improper care, improper selection and improper adjustment of nozzles can make chemical weed control completely ineffective regardless of how effective the chemicals may be. Nozzle tips used in our area are made of relatively soft materials such as brass. If hard objects such as wire are used to clean them, the spray pattern will become distorted and the discharge will most likely increase. Compressed air or a sharpened point of a match stick should be used for cleaning. Investing a little time in cleaning the nozzle screens and tips each day before going to the field will pay dividends. Operators

who wait until all nozzles become clogged before they stop to clean them are completely inefficient in this respect. Nozzles and screens should never be allowed to remain in the sprayer system without cleaning during the off-season. If they are not cleaned, the sediment on the screens dries out and becomes difficult to remove often resulting in replacement of the screens.

Summary

A summary of the high points in the efficient use of sprayers is given below:

1. Train operators in the proper application of chemicals as well as the care of the sprayer.
2. Start the season with a clean machine and keep it that way.
3. Do not guess in calibrating. Take time to do it properly.
4. Use the proper nozzle size.
5. Clean nozzle tips and all screens daily.
6. Adjust nozzles for the application.
7. Be maintenance conscious.
8. Use caution in handling and mixing chemical herbicides.
9. Keep it clean, apply it right to keep your troubles light.